BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

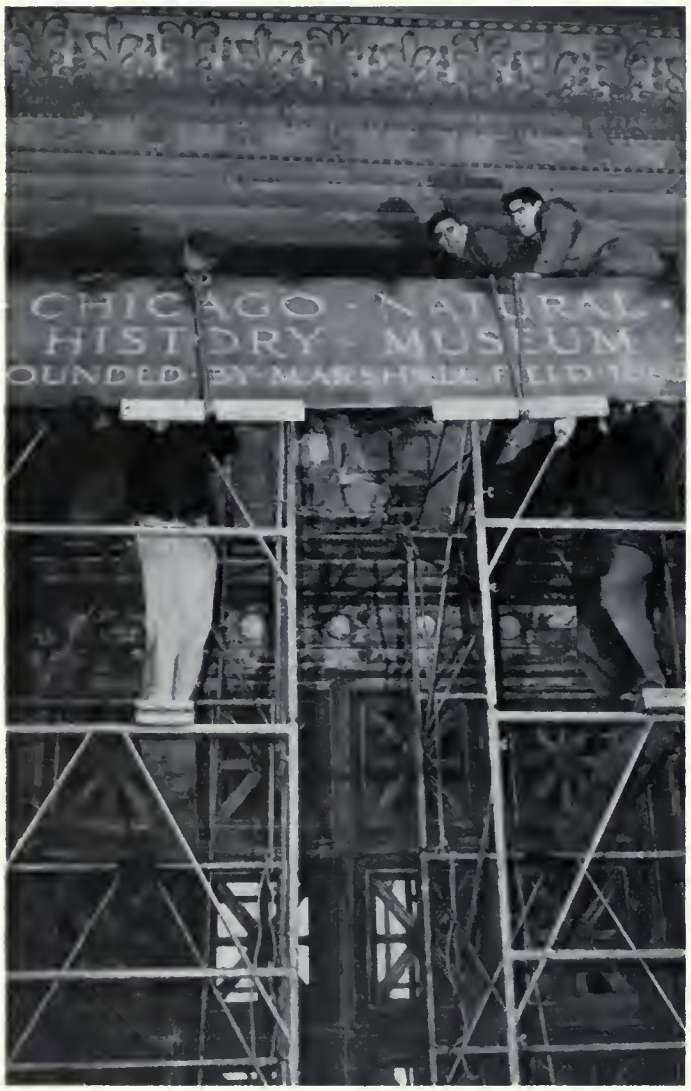
Volume 37, Number 3 March, 1966

SHOUT
SHARE
IT

FIELD MUSEUM AGAIN

Name Change Honors Field Family

by E. Leland Webber, Director



Museum workmen lower bronze nameplate from main entrance. After recasting, 700 pound plaque, bearing the new name, will be remounted.

A significant milestone in the history of the Museum was marked on March 1 with the restoration of the earlier, and still more familiar and popular name, Field Museum of Natural History. This decision of the Board of Trustees was made to honor the several members of the Field family who contributed for more than seventy years toward building one of the world's great museums.

The Museum was made possible in 1893 by a gift of $1,000,000 from Marshall Field, the founder of Marshall Field and Company. Mr. Field died in 1906 and under the terms of his will the Museum received a bequest of $8,000,000. This major gift, one of the largest which had been given to any American museum to that time, provided the funds to construct the present building, completed in 1921, as well as a sizable endowment.

Mr. Field's grandson, Marshall Field III, made contributions between 1925 and 1949 approximating in amount those of his grandfather. His major gift, made at the time of the Museum's 50th Anniversary in 1943, was the stimulus for the institution to enter the greatest period of growth in its history. From 1943 to 1965 the size of the staff doubled and the size of the collections more than tripled. The collections now number approximately 10,000,000 specimens and rank with those of London, Washington and New York as world research resources. An expanded program of scientific research resulted in the publication of as many scientific publications in the ensuing 22 years, as had appeared in the first 50 years. The Museum library, in 1943 a small library containing much miscellania, has more than doubled in size to 160,000 volumes. Of greater significance than its size, is the strength and balance of the library's holdings. Since 1943 many of the exhibit halls have been modernized or completely reinstalled.

Stanley Field, nephew of the first Marshall Field, served as President and Chairman of the Board of the Museum for more than 50 years, until his death in 1964. He made large financial contributions to the Museum, but even more important, he, more than any other individual, built the distinguished institution that exists today. The word "built" is used advisedly, for he planned and oversaw the construction of the present structure and developed the Museum in a balanced fashion. It is probable that no comparable record of personal dedication of time and gifts exists in the history of American museums.

Other members of the family have also served the Museum. Marshall Field II and Marshall Field IV were

After the February 21 Board Meeting at which trustees of Chicago Natural History Museum voted unanimously to restore the former name of the Museum, Mayor Richard J. Daley and Director E. Leland Webber addressed staff members, visitors and representatives of the press. A bronze bust of Stanley Field, sculpted by Mr. Field's close friend Malvina Hoffman, was unveiled by the Mayor and Mr. Webber. Miss Hoffman, the internationally known sculptress, created the "Races of Man" exhibit at Field Museum. The bust will be displayed permanently in Stanley Field Hall, the great central gallery of the Museum.

Trustees during their lifetimes, and Joseph N. Field has been a Trustee for more than 30 years.

With the Museum firmly established from its early years, thousands of individuals, and numerous corporations and foundations, have also contributed generously to its progress. The number of Members passed 10,000 during the past year, and an increasing number of our Members are giving toward current needs. The Chicago Park District has contributed tax funds to the Museum in partial support of certain basic operating expense since 1895. During the last 15 years, the federal government, principally through National Science Foundation, has given important financial assistance to certain of the Museum's research activities.

The lives of institutions often fall into rather clearly defined patterns, much as do the lives of people. Field Museum's history has completed two distinct periods. The first 50 years, ending with World War II, was the period of founding, building construction, establishment of core collections, and mass installation of exhibits. During the second period, following the war, the Museum reached maturity, after undergoing a period of intense growth.

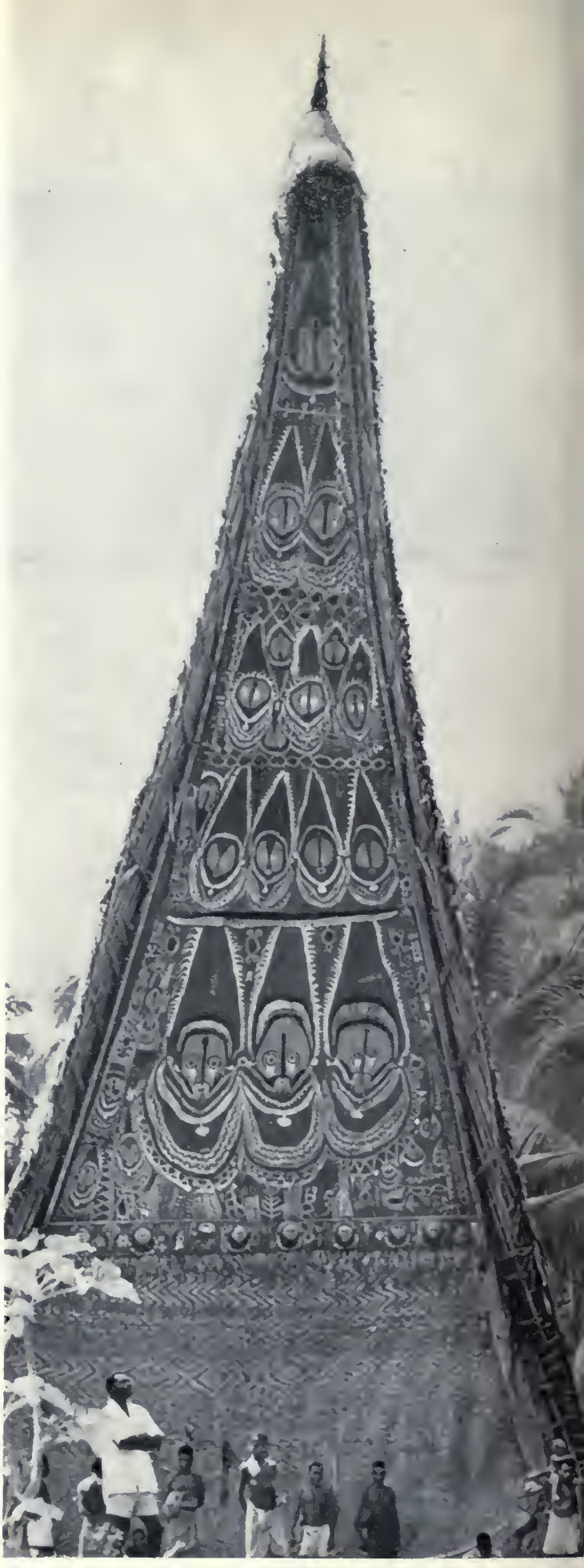
Now, as the Museum approaches its 75th Anniversary, it is entering a new phase of its life. No institution, however great, can stand still; it must either progress or retrogress. Therefore, we are embarking on a planned program of institutional development to bring about needed building improvements and strengthened exhibition, educational, and research activities. The newly completed Library and Department of Geology building additions and the Conservation Laboratory in the Department of Anthropology are first steps in the plan. If the Museum is to progress toward its goals and is to maintain its eminent position as one of the great

Marshall Field I *Stanley Field* *Marshall Field III*

cultural institutions of the Chicago area, it must turn toward its Members and the community as a whole for financial support. We are confident that this support will be forthcoming. It is altogether fitting that as Field Museum looks toward the future, it does so bearing the Field name, in appreciation of the financial aid of the Field family, and particularly in recognition of the lifetime of dedicated and sustained service of Stanley Field, both of which created the greatness on which we are privileged to build today.

PAINTINGS OF NEW GUINEA

by Phillip Lewis, Curator, Primitive Art



An exhibition of paintings and drawings from the Territory of New Guinea opens on Friday, March 4 in the Museum's new temporary exhibition hall. The art comes from two different peoples of the Territory of New Guinea, the Abelam, who live in the Maprik district of the Sepik River region of New Guinea, and the Kilenge, who live on the western tip of the large island of New Britain, which lies just east of New Guinea. The paintings and drawings resulted from the efforts of Dr. Robert MacLennan and Dr. Philip J. C. Dark, who separately urged the two tribes to produce, with Western implements and materials, aspects of their aboriginal art. A number of paintings and drawings resulted, with some interest for the study and appreciation of Melanesian art.

MacLennan served as research medical officer of the government of the Territory of New Guinea in 1963 and was stationed at Pukago village of the Maprik district. He persuaded the people living there to make a series of paintings for him, on paper, using powdered tempera paints. Abelam paintings are usually done with native colors, on large rectangular sheets of sago spathe, the fibrous sheath which envelops the flower cluster of the sago palm tree. The paintings were made to be displayed on the facades and in the interiors of the giant, 60 feet high, men's houses. Painting on paper resulted in a kind of gouache painting rather like the aboriginal paintings. The fact that they were done on paper for MacLennan made it possible for him to collect them without defacing the men's houses. However, in spite of the use of foreign materials and the artificial stimulation by an outsider, the Abelam apparently valued the new paintings somewhat like their traditional ones, for women were barred from watching the painters as they worked with temperas and paper.

(Continued on page 6)

COVER: *Kilenge artist, working with marking pen, island of New Britain.* OPPOSITE: *60-foot Abelam house front, decorated with paintings on sheets of palm fiber.* THIS PAGE, BOTTOM, *enlargement of house panel from page 4;* TOP, *three Abelam paintings in tempera on paper, showing a relationship with house decorations. The Abelam live in New Guinea.*

The show is a joint undertaking of the Art Department and the Department of Anthropology of Southern Illinois University at Carbondale. Dr. Philip J. C. Dark, Research Associate of this Museum and Chairman of the Department of Anthropology at Southern Illinois University, was assisted in compiling the catalogue and in staging the exhibition by Dr. Robert MacLennan, of the Division of Epidemiology of Tulane University, and by Mrs. Loretta Hill of the Department of Anthropology, Southern Illinois University. Dr. Adrian A. Gerbrands, Associate Director of the National Museum of Ethnology, Leiden, The Netherlands, and visiting Professor of Anthropology at Southern Illinois University, acted as consultant for the exhibition. The Office of Research and Projects of Southern Illinois University has kindly allowed Field Museum to present the exhibition here.

In 1960, the Museum of Primitive Art exhibited some Abelam paintings, also made on paper. Those paintings were collected by Anthony Forge, who spent 1958–59 studying the art of the Abelam people. The results of his field work are not yet published, but in his Notes on Eastern Abelam Designs on Paper, in *Three Regions of Melanesian Art*, the Museum of Primitive Art, New York, 1960, he says,

"All Abelam painting is executed by groups of men under the direction of a master artist who paints the white and supervises the painting of the other colors. Apart from Tsigula, [the most knowledgeable painter of the village in which Forge worked] few of the [villagers] . . . were . . . believed by their fellows to be sufficiently expert . . . to undertake the direction of a complete design, so that in some of [Forge's] examples even the painting of the white lines is the work of a group."

Dr. MacLennan met Anthony Forge and became interested in Abelam painting. We do not know if MacLennan's paintings were done collectively as described by Forge.

The Kilenge drawings were collected in 1964 by Dark and Joel Maring, a linguist, on a field trip to New Guinea and New Britain. Dark was looking for a place where he could later pursue a research project to study the art and language of a Melanesian people who had still kept much of their traditional culture. He chose the Kilenge speaking people of the western tip of New Britain, where a number of Kilenge villages will be studied by Dark and Dr. Adrian A. Gerbrands later this year. In 1964, Dark stayed with the Kilenge and inspired the drawings shown in the exhibition.

The photographs on this page show two masked Kilenge figures, and Kilenge renderings of these masks in marking pens on paper.

The exhibit on the art of Melanesia will be shown in the Museum's new exhibition lounge in Hall 9W, recently remodeled as the first in a series of lounge-exhibition areas located in various halls.

Unlike the Abelam, the Kilenge did not make paintings for display as house facades, but did paint designs on canoes, and on other objects, especially several kinds of masks. The Kilenge made drawings on paper with marking inks, not only of designs used on canoes, but also representations of the three dimensional masks. Thus the Kilenge were not only enticed into using unfamiliar materials and making traditional designs with them, but also made an excursion into representing, by means of two dimensional drawings, the three dimensional masks they know.

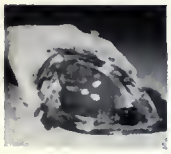
The exhibition thus presents two exercises in transformation of art by new media, and in so doing, allows us a glimpse of traditional art forms as seen from "inside" the cultures. The idea of people making paintings and drawings of their traditional art is not new but it does raise new possibilities for studying fast-dying primitive art in the field by making available an insider's view of the art.

In these days of rapid and irreversible change, experiments which deepen our insight into traditional art and culture are valuable.

GEMS AND MINERALS

by Edward J. Olsen, Curator, Mineralogy

Three new and exotic specimens of gems and minerals are now on exhibit in the Museum. Two are extremely unusual in size and perfection, the third is rare because of its exquisite workmanship.



The first, a flawless, faceted, blue topaz, weighs 5,890 carats, or translated into English, two pounds and nine ounces! The stone, which was found in a creek bottom in Brazil, has been faceted into a beautiful teardrop-shaped gem measuring five inches long by three-and-one-half inches wide by two-and-three-quarters inches deep. It is the largest faceted blue topaz in the world.

Topaz is occasionally found as rough stones of remarkable size. For example, in H. N. Higinbotham Hall here at the Museum we have had on exhibit for many years a rough (unfaceted) topaz that weighs over 205,000 carats, or over 87 pounds! It is a fairly flawless piece, too, but it is *colorless*. Large *blue* stones are much more rare. Another controlling factor in the size of a *faceted* stone is the size of the equipment used. Except with special equipment, most gem cutters cannot handle such large stones at all.

In terms of size also, a recently acquired specimen of the common mineral, quartz, is outstanding. Quartz is one of the three most common minerals on the surface of the earth. Ninety-eight percent of the time it occurs as featureless white or glassy grains in sandstones, granites, and similar rocks, or as grains making up the sand of most of the beaches of the world. In a number of cases quartz occurs as crystals, with natural crystal faces, ranging from the size of pin heads to slender prisms about a foot long. In rare cases, quartz crystals occur in monster sizes; however, the bigger they come, the less chance they will have smooth, well-formed crystal faces.

The Museum was fortunate enough to acquire a single, well-formed quartz crystal weighing 350 pounds. The crystal, a huge terminated prism bounded by its own crystal faces, stands two feet five inches high, is fifteen inches wide, eleven inches deep, and measures just under four feet "around the waist." It was found near Hot Springs, Arkansas. Both the quartz and the topaz were purchased by the John A. Chalmers Fund for the Chalmers Crystal Collection.

Finally, a piece which shows remarkable and exquisite workmanship is a large blue sapphire that measures .82 inches across and has been carved into the face of a woman. The face has been mounted in a diamond-studded platinum setting which forms an intricate, glittering headdress. The stone is deep blue in color and the carving was done with great skill to yield a satin-smooth finish. Sapphire is a name given to deep blue varieties of the mineral corundum, which is most commonly brown in color. Carving sapphire is no easy task because corundum is one of the hardest minerals known (softer than diamond, but harder than topaz or quartz). This stone was donated to the Museum in the memory of Mrs. Chauncey B. Blair through the great generosity of Mrs. Italia B. de Soriano of Chicago.

The topaz is on special exhibit adjacent to The Hall of Jades.
The quartz may be seen in Stanley Field Hall.
The sapphire is on display in The Hall of Gems, (H. N. Higinbotham Hall).

NSF Grant to E. R. Blake, Curator of Birds

National Science Foundation has awarded a $33,000 grant to Field Museum in support of the initial two years of work on the preparation by Emmet R. Blake, Curator of Birds, of the first comprehensive synopsis of tropical American birds. As this fauna accounts for more than one-third of the world's species and far exceeds that of any other zoogeographical region, there is increasing need for a synthesis that will satisfy the requirements of investigators in several fields.

The proposed "Manual of Neotropical Birds," in several volumes, will treat all of the species and subspecies—totalling more than 8,000 named forms—accredited to the area from Guatemala to the southern tip of South America. It will include pertinent descriptive information and data that is either largely new or not readily available, and will therefore be an invaluable research tool for ornithologists, parasitologists, ecologists and zoogeographers, whether working in the laboratory or at a tropical field station. The manual is scheduled for completion in about eight years.

Mr. Blake, a specialist in Neotropical birds, has been with the Museum since 1935. He has made numerous field trips to Central and South America, and has published the results of his investigations both in this country and abroad. In 1964, he was elected an Honorary Member of the Asociación Ornitologico del Plata (Buenos Aires) in recognition of his "valuable contributions to the knowledge of neotropical birds." This new project continues the long history of interest by staff members in the natural history of Latin America, interest which has produced a number of definitive studies of the area.

Spring Journey, 'From Expedition to Exhibition'

The Spring Journey for children, titled FROM EXPEDITION TO EXHIBITION, is centered around the new Zoology exhibit, *The Flow of Information*. Available during the months of March, April and May, this Journey through the Zoology exhibition halls is designed to teach something about the work of museum scientists, explaining the significance and methodology of specimen-collecting, and giving an idea of how exhibits are prepared.

Children often ask how the museum gets its specimens. Part of this question will be answered at the EXPEDITION case, which deals with the work of the curator in the field. At the RESEARCH case, young students will discover that much of the scientists' time is spent in study. The importance of publishing findings to inform others of their discoveries and conclusions is also stressed. The use of this published material, intended primarily for other scientists, as source material for popular works on scientific subjects is brought out in the case called COMMUNICATIONS. Books on bird identification are used as an example of this type of information flow.

Finally, the EXHIBITION case, which is frequently used to show children that the animals displayed are not "stuffed," gives them some idea about the work involved in preparing the exhibits, and brings the Journey full circle, back to the children's point of departure.

Additional sources of specimens, other exhibition techniques, and other uses of the research collections are covered in the remainder of the Journey, which is the 45th in the quarterly series sponsored by the Raymond Foundation.

Shell Club 'Fair' Opens March 1st

THE SECOND ANNUAL CHICAGO SHELL FAIR is being presented in the Museum during the month of March. Colorful, rare, and famous shells are displayed in Stanley Field Hall in a series of eight cases designed by members of the Chicago Shell Club. Response to the first show, held here for two days last year, was so great that the present exhibit has been extended to a full month.

The Chicago Shell Club, which was started in the fall of 1964, meets at 2 P.M. the second Sunday of each month at Field Museum. Those interested in shells and shell collecting are invited to attend.

FIELD MUSEUM OF NATURAL HISTORY
Roosevelt Rd. & Lake Shore Drive
Chicago, Illinois 60605
Founded by Marshall Field, 1893

BOARD OF TRUSTEES
Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
Walter J. Cummings
Joseph N. Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Edward Byron Smith
Louis Ware
E. Leland Webber
J. Howard Wood

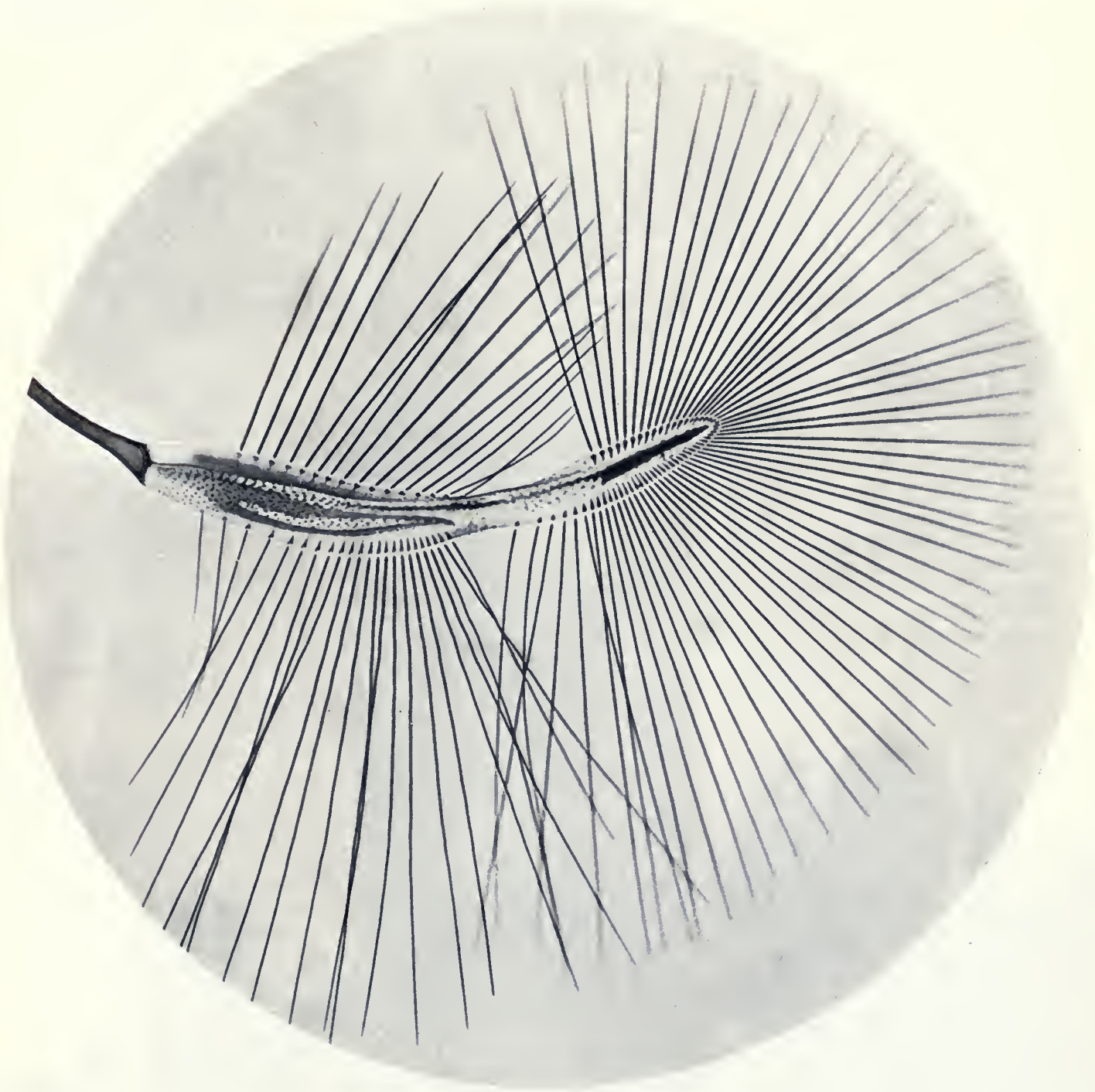
HONORARY TRUSTEE
William V. Kahler

OFFICERS
James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM
E. Leland Webber

CHIEF CURATORS
Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Kathleen Wolff, Associate Editors



Volume 37, Number 4 April, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

May 6

FIFTEENTH MEMBERS' NIGHT SET

Maya
Stone
Rubbing

The Fifteenth Annual Member's Night will be held here on the evening of May 6. As in years past, offices and laboratories will be open to members, and curators and staff members will be on hand to talk about the most recent developments in the Museum's research and exhibition programs.

The highlight of the evening will be the opening of a special exhibit in Hall 9 Gallery, the Museum's new lounge-exhibition area. The exhibit, entitled "Maya Art, Rubbings from Stone Carvings", will show forty-three ink rubbings on rice paper, made by Mrs. Merle Greene. The rubbings were taken from stone bas-reliefs found in Mayan temples, and from stelae in the ceremonial plazas of Mayan cities of Guatemala and Mexico. The rubbings will be supplemented by Maya sculpture lent by the Museum of Primitive Art in New York, the Art Institute of Chicago, and leading Chicago collectors.

Nearby, Dr. Kenneth Starr, Curator, Asian Archaeology and Ethnology, will demonstrate the techniques involved in making rubbings of stone reliefs. This demonstration will give members an appreciation of the similarities and differences to be expected between an actual stone bas-relief and the rubbing made from it.

Other events scheduled for Member's Night include:

A color slide show on "The Natural History of the Harar Highlands, Ethiopia", given by Dr. William C. Burger, Assistant Curator of Vascular Plants.

Display of the terrestrial and flying mammals taken in the recent Street Expedition to Afghanistan.

Demonstration of the use of stereo photographs in the study of fossil Australian mammals, by Mr. William Turnbull, Associate Curator, Fossil Mammals.

A graphic presentation of the functions and operations of a large herbarium, entitled "It's Cut and Dried."

"Chromosomes and serum proteins in taxonomy," exhibited by Dr. Charles F. Nadler, Associate in Mammals, illustrating new techniques in animal classification.

Dr. Glen Cole, Assistant Curator of Prehistory, will discuss the functions and classification of paleolithic stone tools.

The Division of Insects will display trays of unusual and colorful insects. A demonstration of methods of preparing insect specimens will also be offered.

Among the newest additions to the Museum, the Robert R. McCormick Conservation Laboratory will demonstrate methods of cleaning metal artifacts.

The Taxidermy Division, always one of the most popular stops on Member's Night, will be open as usual, showing work in progress, and its vast collection of animal skins.

The Museum will be open to Members and their guests at 6:00 P.M. The offices and laboratories will open at 7:00 P.M. Dinner will be available in the Museum cafeteria from 6 to 8. Free shuttle bus service will operate from Jackson and State to and from Field Museum at frequent intervals starting at 6:00 P.M., the last bus leaving the Museum shortly after the close of Member's Night at 10:00 P.M.

Members meet Staff in
Stanley Field Hall

Biological miniaturization

featherwing beetles

By Henry S. Dybas, Associate Curator, Insects

One of my special research interests is in the smallest known beetles, the featherwing beetles (scientific name: Ptiliidae). The common name derives from the curious structure of the wings, one of which is shown on the cover. These beetles are minute; the smallest are only one seventy-fifth of an inch long. This is less than the size of some single-celled Protozoa, yet they have compound eyes, antennae of many segments, complex mouthparts, wings, and all the other essential parts of their larger relatives. Almost none are longer than one twenty-fifth of an inch. They are truly remarkable examples of biological miniaturization.

Because featherwing beetles are so small, most biologists never see them in the field, even though they may be very abundant. The family is world-wide in distribution and occurs in moist places like the leaf litter of the forest floor, treeholes, under bark, logs, or decaying seaweed on beaches. Each situation will have its own particular kinds of featherwing beetles. Sometimes several hundred can be found in a square foot of forest floor. It seems that they feed chiefly on spores and hyphal threads of molds and other fungi in decaying organic materials. They form a component of a complex, but little understood, web of life that is the biology of our soils. One of the attractions of investigating such little-known creatures is that so much remains to be discovered about them. Some of our commonest species have not been described or named yet, and almost nothing is known of their life-cycles, behaviour, or modes of life. Nearly everything one learns about them is completely new.

Recently, I have been reviewing a genus of featherwing beetles that is very abundant in Florida and the adjacent Gulf States, in decaying leaves and other materials on the ground, but that has completely escaped record in the United States. I now know of seven species in Florida, and another from the nearby Bahama Islands, which need to be described and named for the first time. In large part, these new species are the result of intensive and specialized collecting by Dr. Walter Suter, a young biology professor at Carthage College in Kenosha, Wisconsin, and by Mr. J. Harrison Steeves, Jr., a prominent architect in Birmingham, Alabama. Mr. Steeves' hobby of collecting and studying tiny beetles must appear remarkably esoteric to his business associates.

Feather wing beetle magnified 100 times. Position of egg is indicated by dotted line.

The main collecting technique involves the use of the insect funnel. The principle of the funnel is very simple. Moist forest floor or other debris likely to contain insects is placed in a shallow layer on a screen in a large funnel. Heat, usually from an electric light bulb, is applied from above. As the debris gradually dries or heats up, the tiny insects move down deeper through the debris where, in nature, it would ordinarily be more moist and cool. In the funnel, though, they pass through the screen and fall down the steep slopes and collect in a vial attached to the spout. An astonishing number and variety of tiny insects and mites can be extracted in this way from small amounts of debris. There may be several thousand in a square foot of forest floor a few inches thick. This simple technique, originally devised by an Italian entomologist named Berlese, made it possible for the first time to sample systematically the microhabitats of an area for tiny insects and related arthropods and to obtain adequate series for study.

Tiny beetles like the featherwings must be prepared as microscope slide mounts for study. This is somewhat more delicate and tedious than mounting insects of ordinary size. But it provides a wealth of information, not only about the structure and relationships of these little animals, but indirectly about their biology. For instance, it soon became evident, in my examination of this genus, that there was never more than one egg in the abdomen of the female, for the simple reason that the egg was relatively huge—fully half the length of the beetle! The explanation for this phenomenon was pointed out for some other kinds of arthropods not too many years ago by the noted biologist Bernard Rensch, who stated that each egg needs to be provided with enough yolk for the embryo to develop and hatch into a self-sufficient larva. Hence there is a size-limit beyond which the egg cannot be reduced

COVER: Photomicrograph of the wing of a featherwing beetle, magnified 200 times.

in most insects and related forms. Evolution of small size opens up many new food sources and living spaces. In the process, however, the number of eggs that can be accomodated and matured in the abdomen must become fewer and fewer until, finally, the irreducible minimum of one egg is reached and a limit to further reduction in size is imposed. Presumably, featherwing beetles are now at the size limits dictated by their mode of development and way of life. No one knows how long a female featherwing beetle can live and reproduce, nor how long it takes a single egg to mature or a larva to develop. Yet it would seem that the total egg output per female must be very low in comparison with that of many other insects. So the abundance of featherwing beetles in some situations becomes something of a problem to explain. There must be some compensatory mechanisms such as increased speed of development, continuous (rather than seasonal) reproduction, and other factors, but at present we know too little about their biology to know what these compensatory mechanisms might be.

The temperate forest floor is a typical habitat for many kinds of featherwing beetles.

SIZE
FEATHERWING BEETLE
(IT WOULD TAKE 23,000,000 OF THESE TO WEIGH AS MUCH AS THE GOLIATH BEETLE.)
GOLIATH BEETLE (AFRICAN)
MOUSE

A comparison in size, from a Museum exhibit. The featherwing beetle is inside the circle but can't be seen in the photograph. It can barely be seen in the actual exhibit. A dozen or so small featherwing beetles could be placed on the head of a pin.

Another consequence of small size is its effect on wings and flight. The normal insect wing acts aerodynamically like that of a bird or airplane wing—a flow of air over the surfaces provides lift. In the size range of the featherwing beetles, though, the viscous drag forces of the air are evidently much greater than any possible lift forces, and the wings can no longer function in the same way.

Flight in such microscopic forms has never been directly observed; it would be technically difficult. The long marginal hairs of the featherwing account for most of its expanse (see this month's BULLETIN cover illustration.) If, as has been suggested, these hairs bend more easily on the upstroke than on the down, the lift forces may exceed the dragforces and the insect may be able to "row" its way through the air. Other very small insects evidently have encountered the same problems, because a similar "featherwing" has been evolved independently in several unrelated groups of insects, most notably in tiny wasps that are parasitic in the eggs of other insects. Flight of featherwinged insects would seem possible only in still air over short distances. The featherwing is probably an adaptation for floating in the air like a dandelion seed and for dispersing over distances by means of air currents. Such passive dispersal implies wastage, because many featherwing beetles must be wafted to unfavorable places and lost. This adds to the problem of how featherwing beetles manage to get along with such an apparently low egg production.

Another curious feature that emerged in the course of studying these tiny Florida featherwings was the complete absence of males in at least five of the new species. This can not be attributed to accidents of sampling because in one species there were over 9000 specimens collected in more than 30 counties, over a span of eight months of the year, and all were females. I was forced to conclude that these species were able to reproduce without males—a phenomenon that is well-known, though spotty, in the animal kingdom and which is termed *parthenogenesis*.

Why is there such an unusually high incidence of parthenogenesis in these tiny animals? In the long run, parthenogenesis is considered an evolutionary dead end because it precludes exchange and recombination of hereditary materials between different individuals through mating and thus inhibits adaptation to changing circumstances. In the short run, though, there may be several advantages. One that is particularly relevant is that all the eggs produce reproductive females; none are wasted on males. In effect parthenogenesis doubles the reproductive potential of a population in one jump—an enormous advantage to insects that mature one egg at a time. So I arrive at a final thesis. Obscure as they are, there may be a real relevance in studying such tiny insects. They are important in their own right because of their activities and because of their complex relations with other forms of life in our fields and forests. And because they are faced with extreme problems as a result of their small size, their study can provide insights into problems of general biological interest.

mountain building IV

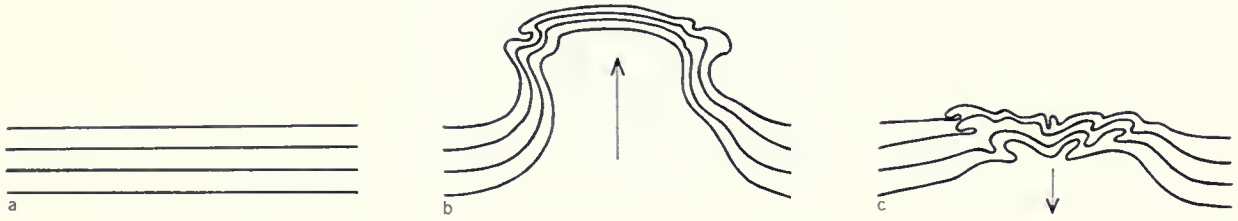
By Bertram G. Woodland, Curator, Igneous and Metamorphic Petrology

MOUNTAIN BUILDING BY VERTICAL MOVEMENTS—As we have noted earlier, there has been a revival during the last thirty-five years of the old concept of the fundamental importance of vertical movements in the evolution of crustal structures, particularly in mountain building. The significance of these hypotheses is that the folding and thrusting of rocks as well as their uplift is explained as arising from vertical movements. They dispense with the idea of primary horizontal compressional forces transmitted through the crust, which is the heart of the contraction theory. The geologists investigating the structure of the youthful mountains of the Indonesian islands and those working in the diverse orogenic and non-orogenic regions of the Soviet Union were impressed with the evidence of alternating vertical uplift and subsidence of the crust. At the same time they believed that it was unlikely that sufficient lateral compressional force could be transmitted through the crust to explain the crustal thickening, uplift, and deformation of a whole orogenic belt. This view was enhanced when the contraction theory met the difficulty that the earth may not be cooling. These geologists also argued against the existence of convection currents in the mantle, which are used in another group of theories to explain the cause of lateral compression and mountain building.

Differential vertical movements can readily explain many geological phenomena. Variations in thickness and type of sedimentary deposit from place to place can be related to varying amounts and varying rates of uplift or subsidence. The deposition of vast thicknesses of sediment in a geosyncline requires a subsidence of the crust of similar degree, assuming the sediments were all laid down under relatively shallow water. We have already mentioned, however, that large amounts of typical geosynclinal sediments may, in fact, have been deposited in deep water, but, because at least some of these previous geosynclines were developed on a continental crust, a large subsidence would still be necessary to depress the crust to oceanic depths. The effects of differential uplift can be seen most obviously in the towering mountain ranges of the Rockies, Alps and Himalayas, the higher parts of which were near sea level some few tens of millions of years ago. No one can thus dispute the importance of vertical movements. The big question is:—How do the advocates of mountain building by primary vertical movements explain the universal appearance in orogenic belts of folding of the rocks on all scales, the thrusting of large sheets over others, and the development of pervasive metamorphic structures such as cleavage? These are all manifestations of compression which generally acted parallel to the earth's surface. They are interpreted as being of local origin, that is, originating within the orogenic belt as a consequence of the primary vertical movements,

and are referred to as secondary gravitational reactions. The structures produced depend on their chronological appearance and their depth within the crust.

The sequence of events may take the following form. A geosyncline develops, is filled with sediment and basic volcanic rocks, and then uplifted, particularly in its thickest portion. The areas adjacent to the uplifted geanticline subside, continue to receive sediments, and form new geosynclines. The rising sedimentary mass becomes unstable, and under the influence of gravity, adjustments take place. Large slices may start to move down slightly inclined slopes. The conditions which enable the whole to slide as a coherent mass include the presence of a lubricated zone of plastic rock material such as clay, and the presence of water filling pores in the basal strata of the sliding mass under pressure of the overlying rock. Also, gravity affects each and every particle, and is thus more potent than a shoving force applied from behind the mass as



A possible effect of uplift followed by subsidence: (a) a series of horizontal strata; (b) uplift with consequent stretching and thinning of the beds (c) subsidence with folding of the stretched beds.

is envisaged in the horizontal force concept of thrust blocks. Obstructions at the front end of the slice will cause buckling, or it may be that some parts overtake others, roll over them and form large complex overfolded masses. Sliding of large rock masses into an adjacent sedimentary basin may also cause slumping and folding of the newly deposited sediments. The rocks of the upper part of a rising block tend to expand sideways, under the influence of gravity, over the adjacent lower blocks. This results in compression of the latter's upper strata, which may crumple and fold. Squeezing of strata may also arise if thick sediments on the flanks of a geosyncline tend to move down into the basin. The thickened sediments may crumple as they slump inwards and downwards and the deepest central zone may become compressed into very tight folds on all scales. The rise of a large welt also results in the stretching and thinning of the overlying sedimentary layer as it accomodates to the increased area. If the uplift should then subside, the layers which are too long, crumple and fold as they settle down on the receding block.

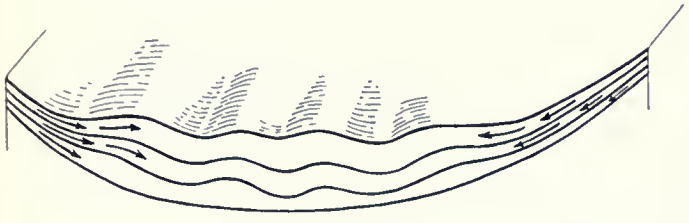
Complex deformation may also arise through differences in density of rock masses. The deep crust beneath a geosyncline say over 10 miles in depth, is believed to be affected by granite-forming processes. Granite has a lower density than average crustal rocks and buoyancy will move it upward through the denser rocks, much as oil droplets released under water rise to the surface. This rising mass, continually being added to from below, deforms the surrounding geosynclinal rocks by compressing and folding them laterally, by dragging them along upwards, and by doming those above. The granite mass is charged with hot solutions and gases which pass outwards and metamorphose the sediments rendering them more mobile, so that they in turn flow from regions of greater pressure to regions of lower pressure, forming intricate folds. If the rising mass should meet a strong resistance to continued upward progress, it may well turn sideways and flow more or less horizontally, dragging with it its envelope of metamorphosed sedimentary rocks and producing large scale horizontal or recumbent folds with granitic cores. Such complex structures are exhibited on fjord walls of eastern Greenland and in the Pennine Alps (within which is the famed Matterhorn). In the shallower parts of the crust, injection structures may also arise by vertical flow of low density masses of rock salt and anhydrite (calcium sulfate). Differential vertical loads may cause flow to particular zones of upward movement resulting in, for example, the salt domes of the Gulf coastal regions. Differential vertical uplifts may also initiate movement of the low density bedded deposits to linear weakened zones where they thicken and cause folding of the cover rocks. The fold mountains of the Jura in northwest Switzerland and adjacent France and Germany are explained in this way.

Causes of Vertical Movements

The cause of primary vertical movements is considered to be continuing chemical adjustments of the mantle rocks in the earth's gravitational field. The changes involve production of less dense and more dense minerals which tend to move in relation to one another; the lighter rising, the heavier sinking. The reactions result in changes of density and volume and, together with the decay of radioactive elements, release heat which in turn causes thermal expansion and promotes mass movements. Beneath orogenic belts differentiation of the upper mantle is supposed to form granitic masses rich in fluids and gases which rise into the lower crust. Magma, formed by melting of crustal rocks and mixed with basaltic magma, rises up channelways to produce the andesitic volcanism that characterizes orogenic belts and the circum-Pacific island arcs. Differentiation of the mantle rock increases the volume and causes uplift, which is further accentuated by the buoyant rise of granitic masses causing the structures previously described. The upward 'flow' of lighter rocks is accompanied by inward 'flow' of heavier mantle rock from adjacent areas, the

surface of which consequently subsides and forms new geosynclinal basins to receive the erosional products and gravity-induced slump from the rising geanticline. In turn, the new geosynclinal areas become subject to uplift and the cycle begins anew. Thus the migration of orogenic belts is explained. Variations in the chronology of subsidence and uplift laterally along an orogenic belt are presumed to be caused by differing incidence and rates of differentiation in the mantle. Outflows of basic volcanic material into the subsiding areas may cause these areas to subside more rapidly than they can be filled with sediments and so produce the deep sea trenches that accompany the island arcs of the Pacific.

In these ways the proponents of vertical movements explain the process of mountain building, volcanism, and intrusion of thousands of cubic miles of granite. In addition, structures of both the stable platforms and ocean basins are referred to the operation of vertical movements. Whereas



Crumpling produced by compressive settling into a depositional basin from the higher margins. Length of section may be up to 75 miles.

mountain building is considered a process of continental growth, evidence pointing to the previous existence of land where there is now ocean is considered to indicate a reverse process of 'oceanization.' This results from massive extrusion of basalt which causes foundering of the sial and downsinking. Areas such as the North Atlantic between Greenland, Iceland and Scotland, the western Mediterranean, and the Sea of Japan are supposed to be geologically young and to have originated through oceanization. A problem that arises is.—What is the fate of the sialic layers, inasmuch as these oceanic areas give no evidence of their presence, seismically or gravimetrically? Several solutions are proposed: (1) The sial is reabsorbed at depth. There is no evidence to support this and it seems strange that a process should operate in the upper mantle which is the reverse of the differentiation process required by mountain building. This idea is countered by the suggestion (2) that basaltic extrusion and oceanization are a developing trend in the evolution of the earth resulting from a gradual change in the differentiation process as the amount of granitic components in the mantle declines. The gradual deepening of large areas of the Pacific during the last 75 to 100 million years, as evidenced by the submerged guyots and volcanic cones of the atolls, is also given to support this suggestion. Another explanation, (3) is that the foundered sial occurs beneath oceanized zones, which form trenches. But since the sialic rocks are unstable at great depths, moving upwards and outwards towards the continent to produce all

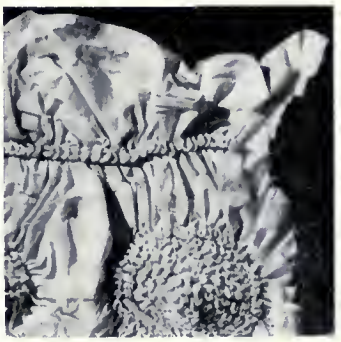
TIE-DYEING SEQUENCE FROM NIGERIA

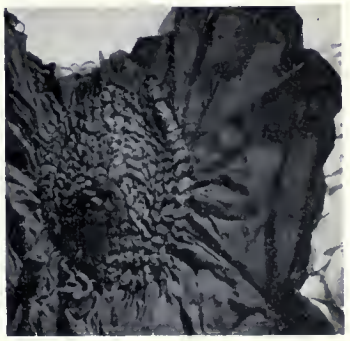
TIE-DYEING AS A METHOD of applying design to cloth without the use of brushes, printing blocks, or other tools more elaborate than string and the dye itself, has been known in parts of Asia, Africa, and Europe for many centuries. The Museum is happy to have received this example of the process in various stages, as the gift of Mr. and Mrs. Robert Strotz of Evanston, Illinois, who collected it among the Hausa people at Kano in Northern Nigeria.

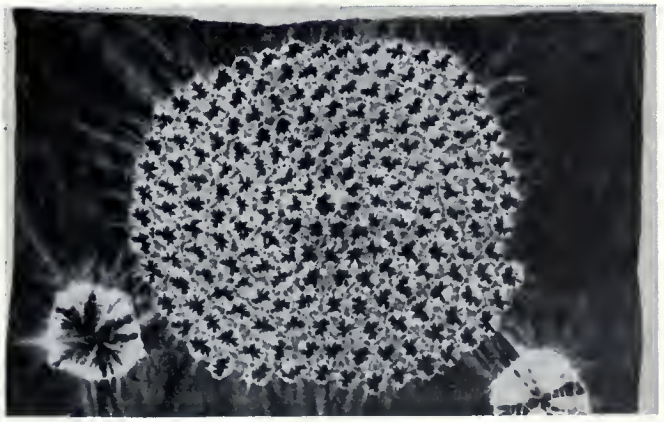
The white cloth used is a cotton of European manufacture. The first photo shows the cloth before dyeing, but already gathered up and tied with strings, to form a design that will appear after the cloth has been dipped and untied. The second photo shows the cloth after dyeing, with the tied "packages" still in place. The dye has not fully penetrated into these packages. As seen in the third photo, where the cloth has been untied after dyeing and drying, the finished cloth reveals the patterns made by the undyed parts contrasting with the dyed background color. Patterns can be very diverse, depending on how the cloth is taken up and tied. This specimen shows a Yoruba pattern adopted by Hausa dyers.

Dark blue is the customary color used in northern and western Nigeria. Formerly indigo was used, but as in this specimen, European commercial dyes are supplanting it.

Note that the cloth in the first photo is tied in a somewhat different pattern from that in the other two.







—Leon Siroto, Assistant Curator, African Ethnology

recent acquisitions—library

JOHN JAMES AUDUBON LETTERS

The Museum has become the fortunate recipient of two letters of the artist-naturalist, John James Audubon (1785–1851). Both date from the time when he had completed his great work of describing and painting the birds of America and was, with the aid of his sons and the Rev. John Bachman, preparing *The Viviparous Quadrupeds of North America.*

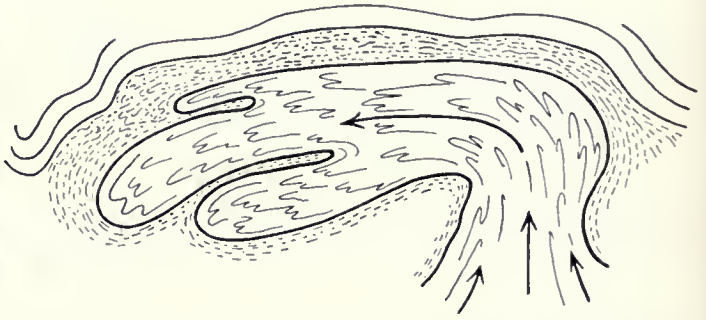
The first letter, the gift of Mr. Herbert R. Strauss, is undated and not in Audubon's handwriting, but is signed by him. It is addressed to David Camden de Leon (1822–1872), who served as a surgeon in the U. S. Army in Florida and Mexico and as head of the Medical Department of the Confederate Army. Audubon requests him to obtain "specimens of such viviparous quadrupeds as may be found with the limits of your jurisdiction [i.e., Middle Florida], or beyond that, if opportunity offers" and gives De Leon some instructions for preparing and preserving them, including the following: "Very small quadrupeds would be better if put into jars of New England rum whole—only cutting a slight slit in the belly to allow the spirit to saturate their entrails. Whiskey or alcohol will not do so well, as they cause the hair to come off."

The second letter, given anonymously, is completely in Audubon's hand and is dated New York, Dec. 26th [?], 1845. It is addressed to Titian Ramsay Peale (1799–1885), an artist-naturalist who illustrated several important works of American natural history. Audubon requests the loan of a "fine painting of a black-tailed deer" and writes that he "will not keep it above three or four days, and will return it to you, in the same order in which I received it. . . ." He concludes, "It is now a long time since we have met, but [I] have some hopes of doing this in the course of this winter. With the good wishes of the season, believe me Mr. Peale, your sincerely attached friend & o[bedient] serv[ant], John J. Audubon."

Both letters will be on display in the Library during the month of April. —*W. Peyton Fawcett, Associate Librarian*

the phenomena of mountain building deformation described above, (i.e., metamorphism, volcanism, and granitizations). Such ideas retain many of the explanatory concepts of vertical movement but reintroduce the necessity of lateral movement.

Vertical movements in the crust and mantle are important since they occur by isostatic adjustment to loading or unloading of the crust, or to changes in density. But apart from requiring such movements to explain the uplift of areas such as the Colorado Plateau, uplift and subsidence are essential elements to mountain building. Vertical movements were formerly regarded as mere resultants of a system of lateral compression which was required to explain the apparent shortening and thickening of the crust by folding and thrusting. It is now clear, however, that many of these latter structures are more readily explained as resultants of vertical movements. The exponents of the primary importance of vertical movements consider lateral compression as a local phenomenon arising within the orogenic belt itself with the resulting folding and thrusting as secondary effects. Evi-



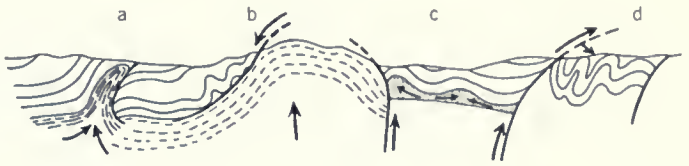
dence has been accumulating during the last twenty to thirty years which indicates that primary vertical movement of crustal blocks is a powerful means of explaining many structural relations. Thus, the separate ranges of the Rocky Mountains, such as the Front Range in Colorado, with their crystalline granitic cores and overlying deformed bedded sedimentary rocks are the result of primary vertical uplift. Differential uplift and subsidence, reaching from five to ten miles in some places, began between about 100 and 75 million years ago, and uplifts of over a mile have taken place over the last few million years. The rising blocks were subject to erosion, while thick sediments accumulated in the intervening basin. Folds and faults formed along the flanks as a consequence of the uplift and in the more strongly uplifted segments, large slices of sedimentary rocks glided under gravity to form far-travelled thrust sheets. However, the Rocky Mountains differ from a typical orogenic belt in that the uplifts were accompanied by only a relatively small amount of igneous intrusion and metamorphism, at least at the level in the crust now exposed by erosion. Large granitic intrusions, dated at between 80 and 140 million years ago, occur to the west in the Sierra Nevada Mountains of California, in Idaho, and in the Coast Ranges of British Columbia. These seem unrelated to the Rocky Mountain uplift, although apparently marked uplift of the Sierra Nevadas also has taken place since about five million years ago.

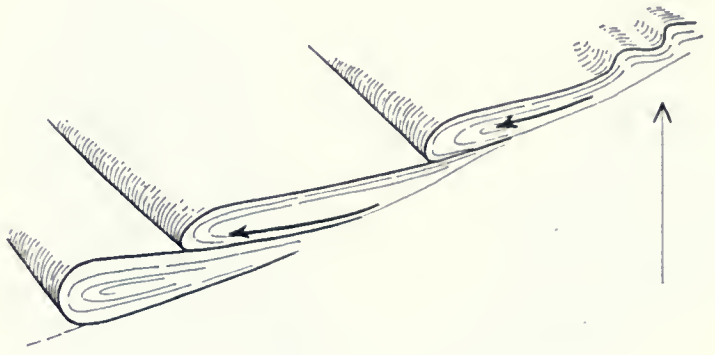
TOP RIGHT: *Vertical section of the upper crust illustrating various structures resulting from vertical movement: (a) fold of plastic clay squeezed upward by buoyancy; (b) folding by sliding of beds from an uplifted mass; (c) folds formed by movement of plastic rock salt and/or gypsum to fault zones etc.; (d) crumpling produced by force of outward moving uplifted block. Length of section about 15 miles.*

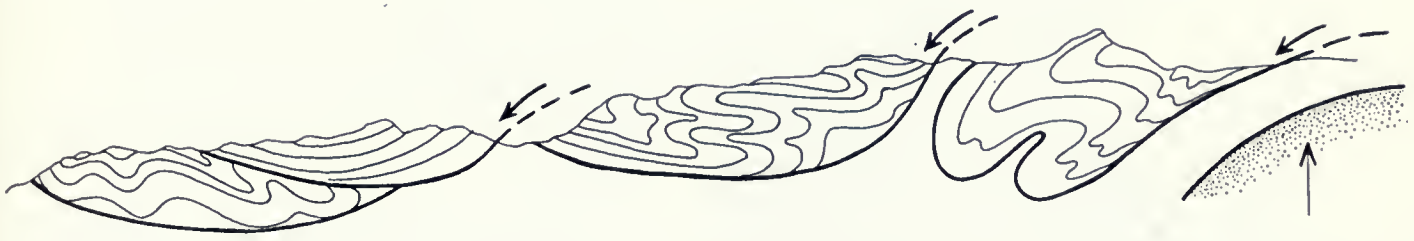
MIDDLE, RIGHT: *Sliding and overfolding of strata to the left following differential uplift of the right side.*

BELOW, LEFT: *Vertical section showing a rising mass of granitic rock (the core) which has turned sideways and produced large horizontally folded masses. The envelope of the core is composed of intensely deformed and metamorphosed rocks, while the upper beds are folded sediments. Length of section, about 20 miles.*

BELOW: *Vertical section showing folded and now detached masses which have slid, under the influence of gravity, off the flank of a rising mass. Length of section about 50 miles.*







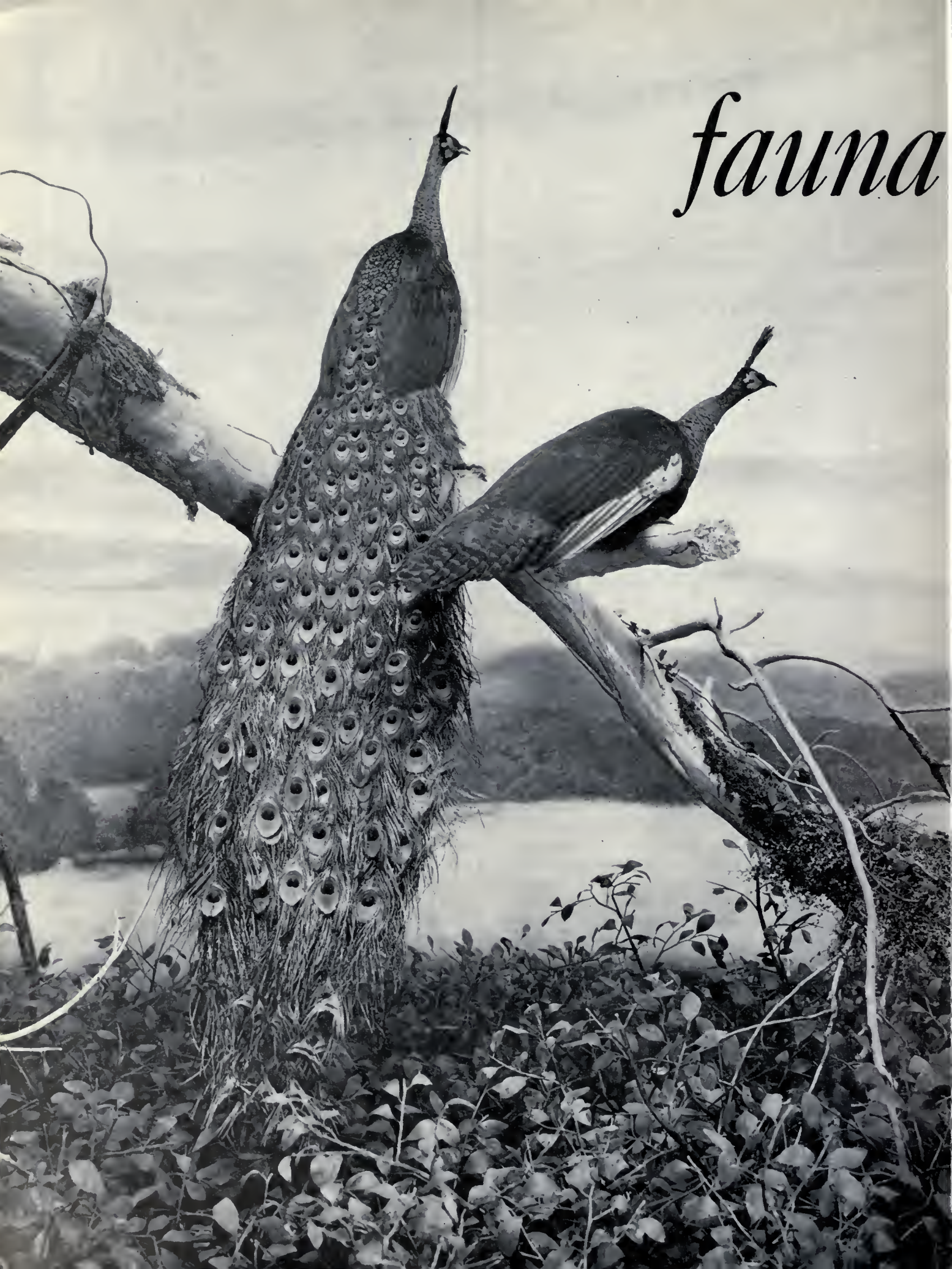
Problems arise with the concept of vertical differentiation of the mantle as the primary controlling mechanism of crustal structure and evolution. First, there is doubt that the chemical differentiation and the attendant vertical adjustments of mantle material could take place over a sufficient depth in the space of time required for the evolution of any single orogenic belt.

Secondly, the location of the orogenic belts would be governed by the location of the changes in the deep mantle, yet the former seems to show a relationship to the distribution of oceanic and continental crust; it is not clear how this would arise. It is also assumed that the andesitic and related volcanic products of orogenic regions and the granitic intrusion material, in part responsible for the uplift and secondary deformation, are new sialic material, added to the crust by differentiation from the mantle. The origin of these rocks remains a problem but it is by no means certain that the bulk of them is derived from the mantle. One alternative is that they are largely derived from pre-existing sial (with some addition of mantle-derived material) and that their accumulation requires more than just vertical movement but lateral displacement as well. Further, it is suggested that the mantle may have largely spent its ability to produce large quantities of granite in the early phases of earth evolution when the sial was formed.

Another difficulty is that many granite intrusions have a much younger radioactive decay date than the deformed metamorphic rocks that surround them. This may reflect their respective cooling histories. That is, the granite maintained a higher temperature at greater depth for a long time after the metamorphic rocks had cooled. The granite's age would then be recorded from some stage in its delayed cooling. The granite moved into its present position long after the metamorphism. However, it may also mean that the granite has no relationship to the metamorphism, or, at least, a much less direct one than is implied in the usual causal relationship in orogenic belts claimed by "vertical movement adherents".

Lastly, the evidence of large lateral movements of crustal blocks, both continental and oceanic, indicates the operation of forces other than just vertical ones. This evidence has become more compelling within the last decade. Even proponents of primary control by vertical movements admit that lateral movements may be propelled by lateral mass transfers in the upper mantle although they relate these to fundamental differentiation and vertical movements in the deep mantle. This then leads to the last remaining series of theories of mountain building, namely, theories that consider convection currents, slow circulations of mass in the mantle, as the source of orogenic forces.

This article will be concluded in a subsequent issue of the BULLETIN.


fauna

By Austin L. Rand, Chief Curator, Zoology

# of Southeast Asia

VISITORS TO FIELD MUSEUM who have more than the general political interest in Viet Nam will find exhibits which give them a very good idea of the country in which so many Americans are now engaged. The political boundaries of North and South Viet Nam encompass a band 1,000 miles long and from 30 to 330 miles wide along the eastern edge of the Indo-Chinese Peninsula, facing the South China Sea. The topography is dominated by deltas and coastal alluvial plains, back of which rise mountains reaching about 11,000 feet in the north, and 6,000 in the south. Lying in the same latitudes as Central America, the country is tropical, with ample rainfall which falls chiefly in the summer, and temperatures near 80° F. all year in the south. The vegetation is chiefly evergreen tropical forest, and rice is the chief crop. The ancient people of Indo-China were Indonesians, but Mongol-like immigrants from the north mingled with them evolving many local sub-races. Although China has greatly influenced Viet-Namese culture, it is apparent that there is also a strong Hindu influence from earlier times.

The Museum's zoology exhibits provide life-like views of the various kinds of country in Viet Nam, and the plant and animal life found in each.

One of the bird habitat groups exhibited in Hall 20 is set in the forested terrain of Viet Nam. Actual native branches and leaves and mounted specimens are used. The background is painted from photographs made in the country:—the time is early morning; a peacock and a hen sit on a dead branch above the forest, overlooking the mist-filled valleys and the tiers of mountains losing themselves in hazy distance. The cock, with his gorgeous train closed, opens his mouth to give the loud, trumpet-like call with which he heralds the new day. Soon he and his consorts will fly down to the forest floor or the edge of a clearing to feed. Then the peacock will display, spreading his train into a great fan over his back and quivering his wings and shuffling his feet. When night approaches, the bird and his mates will return to the trees. A view of this exhibit is like looking through a window onto the Viet Nam countryside.

Nearby, both in the Viet Nam forest and in the Museum exhibit arrangement, a family band of gibbons, the smallest of the great apes, swings through the treetops. The white female has a young one clinging to her breast; the old black male pauses on a branch, holding himself upright with one hand as he plucks a red fruit. A young male is swinging by his arms from branch to branch (a mode of travel called brachiating). The other young male, also black, is flying through the air spread-eagled, to grasp a branch on the far side of a gap in the tree-top canopy. Like the peafowl, the gibbons sleep in trees, however they rarely descend to the ground. But they do greet the new day with their calls:—one starts to howl, the rest of the family takes it up, family calls to family, and the forest rings with their calling.

Another exhibit, set on the edge of a forest clearing in the rugged mountains of central Viet Nam, shows a sable bull gaur, finest of the wild oxen. With him is a cow, less bulky, and more brown in color, and her brown calf with button horns. These forest cattle are distantly related to the beef cattle of the Middle West, but they have a sculptured, majestic beauty which has long since been lost by their domesticated relatives.

While the gaur lives in the mountain forest and is a stately beast, the water buffalo, shown in another habitat exhibit, lives in the tall reeds, brakes, grassy plains, swamps and marshes of the hot lowlands. The buffalo has a great, heavy body, short legs, and long, curved, backward-sweeping horns. There are both wild and domesticated varieties, much alike in appearance. The domestic buffalo is used to draw carts and prepare rice fields. The herds of wild buffalo sometimes come into cultivated fields to feed, and have the reputation of being savage and unpredictable in temperament. As their

Guar

Water Buffalo

CALENDER OF APRIL EVENTS

Through April 13 New Guinea Paintings

Continuation of a special exhibition of paintings and drawings by the Abelam people of New Guinea and the Kilenge of New Britain. Hall 9 Gallery.

April 1—April 30 A Medley of Birds

An exhibition of 24 paintings, by Mrs. Florence Guise, featuring birds of the mid-western United States. Stanley Field Hall.

April 9 Movie: Australia

A study of the people and natural wealth of the land "down under". Narrated by Charles Forbes Taylor. Adults. 2:30 P.M. James Simpson Theatre.

April 16 Movie: High Arctic

Intimate documentary on the life of the northernmost Eskimos, by explorer Lewis Cotlow. Adults. 2:30 P.M. James Simpson Theatre.

April 16 Girl Scout Day: Summer Scouts Go, Go, Go

A look at new summer scout activities-travel camps, art programs and day trips. 10:30 A.M. James Simpson Theatre.

April 19 The Indiana University Opera Theater

University Theater presents "Opera Gala." 8:15 P.M. James Simpson Theatre

April 23 Movie: Timeless Turkey

Turkey seen as a bridge between the East and the West. Adults. 2:30 P.M. James Simpson Theatre.

April 23 Camp Fire Girl Day: Weather and the Space Age

Featuring P. J. Hoff, CBS weather man. 10:30 A.M. James Simpson Theatre.

April 30 Movie: Puerto Rico

A film tour of the island as seen through the eyes of its natives. Adults. 2:30 P.M. James Simpson Theatre.

April 30 Cub Scout Day: What On Earth?

Color motion picture on the world of nature by Fran William Hall. 10:30 A.M. James Simpson Theatre.

APRIL MEETINGS

Open to interested persons

Nature Camera Club, April 12 at 7:30
Orchid Society, April 17 at 2 P.M.
Shell Club, April 24 at 2 P.M.

Southeast Asia (cont.)

name implies, they enter water readily and may frequently be seen submerged, with only nostrils and eyes projecting above the mud and water.

These are our four large habitat groups showing the main habitats in Viet Nam:—mountain, plain, forest, grass and swamp land. Other striking animals whose ranges are common to Viet Nam and India as well, are shown in nearby dioramas with Indian backgrounds—a pair of tigers in the tall grass with their wild-hog kill; a leopard crouched on the branch of a forest tree; and a group of elk-size sambur deer on a dry river bed in light forest.

Scattered through our systematic series are individual specimens of birds, mammals and reptiles that illustrate types occurring in Viet Nam, such as babbling thrushes, various pheasants, fairy blue birds, warblers, flycatchers, sunbirds, monitor lizards, pythons and cobras. Further material on the zoology of Viet Nam is available in our study collections, which have recently been enriched by several large collections of Viet Namese birds and mammals.

FIELD MUSEUM OF NATURAL HISTORY
Roosevelt Rd. & Lake Shore Drive
Chicago, Illinois 60605
Founded by Marshall Field, 1893

BOARD OF TRUSTEES
Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
Walter J. Cummings
Joseph N. Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Edward Byron Smith
Louis Ware
E. Leland Webber
J. Howard Wood

HONORARY TRUSTEE
William V. Kahler

OFFICERS
James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM
E. Leland Webber

CHIEF CURATORS
Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Kathleen Wolff, Associate Editors

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

Volume 37, Number 5 May, 1966

mountain building V [conclusion]

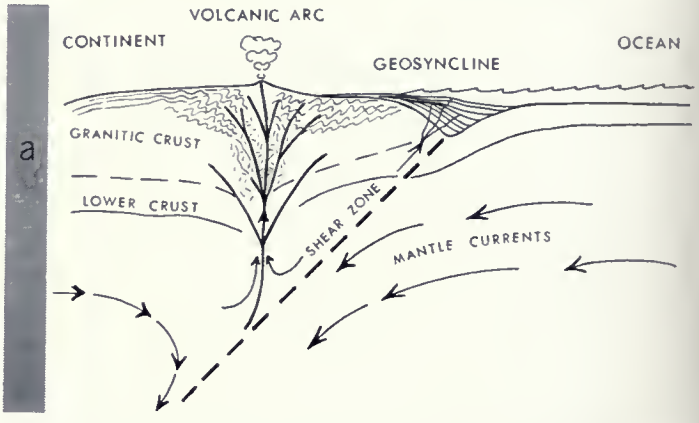
By Bertram G. Woodland, Curator, Igneous and Metamorphic Petrology

Convection Current Hypotheses.—Both from theoretical considerations and in attempts to explain crustal phenomena such as mountain building and volcanism, currents in the sub-crustal layers have been postulated from time to time for over a hundred years. In 1928 Wegener, one of the earlier and better-known advocates of continental drift, suggested them as possible mechanisms for moving continents. In general, this was no more acceptable than the drift hypothesis. One of the major objections was that the mantle, by then considered to be crystalline, could not flow. However, it has been shown that solids, particularly at high temperatures and pressures, will deform by plastic flow or 'creep' if subjected to relatively small differential stress for periods of time of geological significance, that is, for tens of millions of years. In addition, it has been calculated that the rates of flow indicated by certain crustal phenomena, a half inch to two inches per year, are theoretically possible.

In the 1930's some model experiments were made to investigate the effect of mantle currents on the crust. The currents were simulated by contra-rotating drums in a suitable medium at a scaled-down speed. The overlying 'crust' reacted to the currents by thickening and dragging down into the underlying media over the zone between the drums. The thickened zone also showed thrust zones directed outward from the center line. These results strongly supported the idea of mantle currents as the driving force of orogenic belts, and adherents to the hypothesis since then have suggested many variations to account for the phenomena associated with mountain building.

A typical explanation might be as follows: the initial slow development of the currents drags down the crust and forms a geosyncline which receives sediments. Continued downward movement results in heating of the deeper crustal layers which produces partial melting. The products of melting tend to rise and the hot, water-rich solutions in particular move upward and metamorphose the overlying sediments. Acceleration of the currents results in compression of the sediments, their severe deformation, and formation of cleavage as in slates. Then, as the currents slow down, the thickened crustal mass is no longer held down against gravity and it rises isostatically to form a new mountain range. The uplift is accompanied and aided by the buoyant rise of granitic masses produced at depth. As the still hot mass slowly rises through the metamorphic envelope, it causes further chemical and structural changes in the rocks. The uplift also causes the secondary effects of sliding and slumping as described earlier under vertical movements. Erosion attacks the rising mass and exposes ever deeper levels of the orogenic belt with their differing styles of deformation and metamorphic effects.

Deep sea trenches and their accompanying volcanic arcs are considered by many earth scientists to represent the loci of present-day orogenic activity. The prevalent earthquake shocks would originate by the release of stresses generated by the mantle currents which are moving downward beneath the arcs along an inclined zone. It has already been mentioned that earthquake wave data pose a difficulty to this underthrusting concept. Many more data and analyses, however, are required before we can more fully understand the complex problem of deep earthquake movements and their relation to causal mechanism. The characteristic explosive andesitic volcanism can be explained as arising by the fusion at depth of crustal material and sea water solutions carried down by the mantle currents. At some point these rise,



Diagrammatic vertical sections across a developing orogenic belt assuming of convection currents in the mantle as the driving mechanism:

mixed to a greater or lesser extent with basalt produced by partial fusion of the mantle. The magma, highly charged with gases, makes its way to the surface and forms volcanoes. The origin of andesitic and related magma types is, however, still a problem with no generally acceptable solution. A source produced by the partial melting of sialic crustal material with perhaps additions from the mantle is one very plausible explanation, so that the above mechanism accounting for the volcanism is possible.

The question of whether the deep sea trenches can be regarded as modern examples of geosynclines has been discussed earlier (in Part 2). Some recent interpretations of the structure of trenches have indicated little thickening of the crust and an origin by tensional downfaulting rather than by compressional buckling. However, seismic surveys indicate a somewhat thickened oceanic crust which, together with the large deficiencies of gravity over the trenches, means that they are not isostatically compensated. Thus, some force must be holding the trench areas down; otherwise they would rise isostatically. This force is commonly taken to be downturning currents in the mantle which exert a drag on the crust, pulling it downward. Many of the trenches have little sediment thickness and also are located in geographic positions that render it unlikely that large thicknesses of geosynclinal

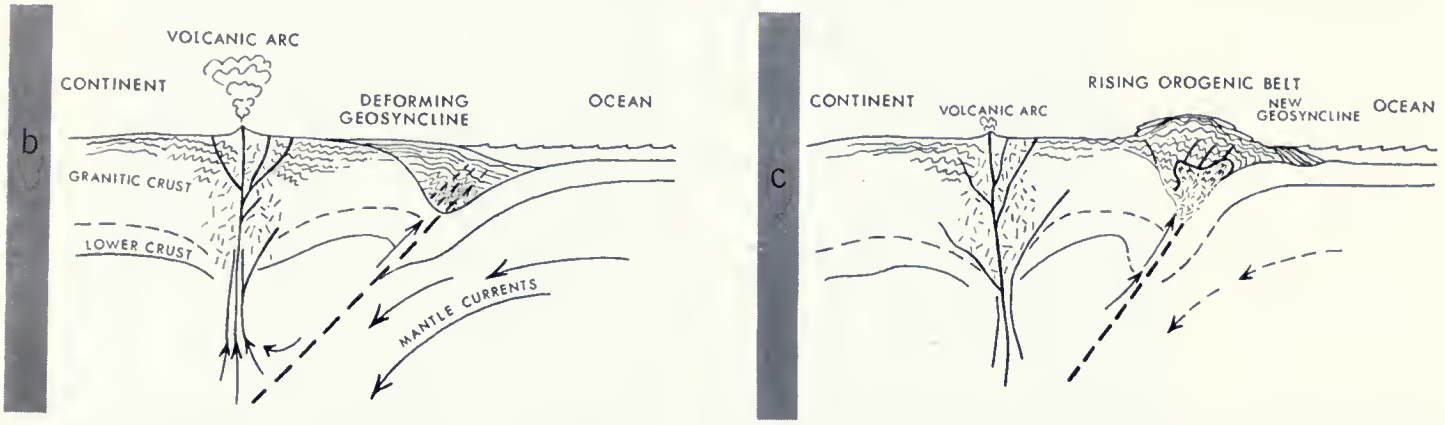
proportions could accumulate. Uplift would not form an orogenic belt but a ridge on the ocean floor. Thus, trenches must be converted to geosynclines by the supply of large quantities of sediment produced by the erosion of mountains of an adjacent continental area. A possible example of such an occurrence is to be found in the Coast Ranges, south of San Francisco. Interpretations of the metamorphic rock suggest that sediment accumulated rapidly in a sinking trough with oceanic crustal structure, roughly in the period between 100 and 120 million years ago. Eventual thickness may have been nearly twenty miles. Metamorphism was followed by deformation and uplift so that erosion now exposes rocks that were once very deeply buried sediments and also fragments of former oceanic crust, partially altered to a very dense type of rock of basaltic composition called eclogite. Perhaps even fragments of the underlying mantle are exposed.

However, other orogenic belts have evidence that the geosyncline that preceded the mountain building was located on continental crust rather than oceanic, though perhaps thinner than average since rocks that may have come from the lower crusts and upper mantle are found in these areas also. Thus, downwarping may affect continental crust. The location of the downsinking portions of currents has been thought to be influenced by the crustal discontinuity of continental borders and the sites of many present trenches support this. Also the supply of large volumes of sediment is linked to the proximity of continents so that geosynclines could develop near the latter. Combination of the two factors produces the elements for an orogenic belt; this combination may be fortuitous. In this respect the location of the Bonin-Mariana and Tonga arcs and trenches is interesting. They do not occur near the continent, and large areas of oceanic crust intervene between them and continental sialic crust. The trenches thus seem destined not to produce mountain chains. The andesitic volcanoes of the associated island arcs are a problem to the theory of andesite origin by refusion of down-dragged sial and mixing with mantle products because of their distance from the nearest continental mass. It is possible that oceanic crust together with the relatively thin oceanic sediments carried down by the currents may suffice to produce andesite. Also the southwest Pacific west of the Tonga trench is a complex region and the crust may be influenced by a geologic history of fragmentation of sialic crust.

The reverse side of the coin may be represented by the very thick sedimentary accumulations along the Gulf Coast and to a lesser extent off the eastern seaboard. The former, particularly, is referred to as a modern geosyncline. However, it lacks the other manifestations normally associated with a nascent orogenic belt,—earthquakes, volcanism and, in fact, any evidence of crustal instability other than a gradual downsinking. Can we then say that the area is unlikely to become an orogenic belt and a future mountain range?

The concept of downturning mantle currents producing the driving force of orogeny, as described earlier, is combined with varying rates of movements to form a single orogenic cycle. Varying rates of movement may also be utilized in a different way. If mantle currents cause drag movements of the crust this will be particularly effective on the deeper zones. This drag may thus remove material from the base of the crust at zones of greatest motion and deposit it under areas of lesser movement. In the former case the crust is thinned; in the latter it will be thickened and rise isostatically. This concept may explain some of the complex structures of the American Cordillera. The thin block-faulted crust of Nevada and western Utah would represent the thinned stretched portion, and the Colorado Plateau the thickened uplifted area. The extensive volcanism of the former area during the last fifty million years might also reflect fusion of sial and its ready extrusion through a thinned fractured crust. The gigantic granitic intrusions of the Sierra Nevadas, of Idaho, and the Coast Range of British Columbia, all with ages largely between 80 and 110 million years, may also represent rejuvenated sial transported at depth from the west.

The Rocky Mountain uplifts represent somewhat of a problem because of the small amount of associated granitic intrusions and metamorphism so typical of the cores of classical orogenic belts. Prior to the uplifts the area in general was a shallow sea and received variable but moderate amounts of marine sediments. The uplifts must be related to deep crustal and sub-crustal processes. If the uplifts are related to crustal thickening from beneath there is no ready explanation for their spotty occurrence with intervening basins either lagging behind or actually depressed. It would seem that viewing the entire Rocky Mountain area as (*continued on page 8*)



a) geosyncline developing; granite forming and volcanism in adjacent belt; b) geosyncline deforming; c) uplift, metamorphism and granite formation as mantle currents wane.

MAYA ART

EXHIBIT OF RUBBINGS FROM STONE CARVINGS

by Donald Collier, Chief Curator, Anthropology

CLASSIC MAYA CULTURE was notable for its complex religion, elaborate rituals and hieroglyphic writing. The ancient Maya achieved an extraordinary knowledge of astronomy and developed a remarkably accurate calendar. They produced monumental architecture, and created a rich and varied art. The sculptural aspects of that art are shown in the current exhibition.

On display in the Museum from May 7 through June 27, the exhibition will include 43 rubbings from stone carvings as well as a loan collection of Maya sculpture. The rubbings, which were made in Mexico and Guatemala by Merle Greene, range in size from 2 x 3 feet to 8 x 12 feet and are remarkable for their high technical quality. They were made by Mrs. Greene over a period of three years in the field, while working as an artist for the University of Pennsylvania at Tikal, Guatemala, and for Tulane University at Dzibilchaltun in Yucatan.

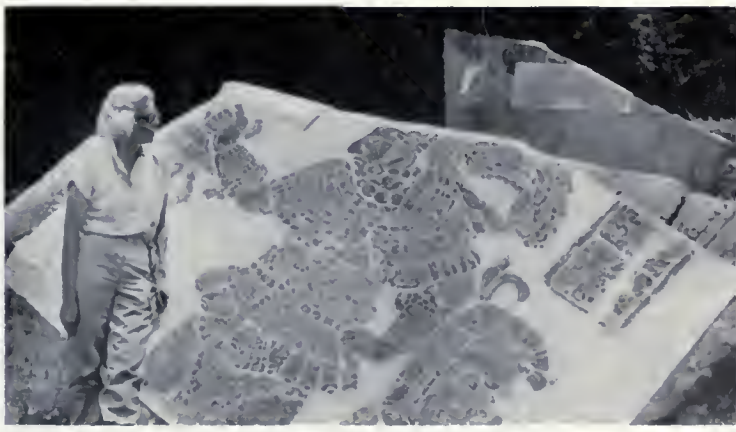
Good rubbings of stone carvings, which of course are life-size, have advantages over photographs because they clarify the designs by eliminating the confusion caused by color variations in the stone. They bring out the low-relief carving better than it can usually be seen on the originals, since ideal conditions of oblique lighting seldom exist in the field. And rubbings, because they are made in actual contact with the carvings, convey a feeling for the texture of the stone. They are therefore valuable both for an appreciation of the refinement and grandeur of Maya art, and for systematic study.

The carvings shown in the rubbings, as well as the sculpture included in the exhibition, date from the Classic Period (A.D. 200–900) and the Post-Classic Period (A.D. 900–1100). Most of the material dates from the Late Classic (A.D. 600–900), the period of highest development of Maya art.

The rubbings are taken from low-relief carvings on limestone monuments called stelae erected in the ceremonial plazas of Maya cities, and from the facades and interiors of the temples that surrounded these plazas.

The stelae (singular, stela), which form the most numerous and important class of Maya carvings, are tall free-standing stone slabs bearing hieroglyphic writing and carvings portraying rulers, priests and deities. They were erected in front of the temples to mark the completion of time cycles in the sacred calendar, or to celebrate the accession of a new ruler, whose portrait was carved on the monument. The stelae bear hierglyphic dates, which can be read, and other glyphs which have not yet been deciphered.

For many years archaeologists have been trying to discover the origins of Classic Maya culture. Most of the visible remains in the jungle dated from the Classic period and such characteristic Classic traits as the corbelled vault in tombs and stone stelae seemed to appear almost fully developed at the beginning of the period. Earlier remains were found at some of the lowland Maya sites, but these were insufficient to explain the Classic development. This situation led to the



Opposite page, above: Rubbing of the sarcophagus lid in the tomb of the Temple of the Inscriptions at Palenque. In the center a royal personage reclines on a throne.

Opposite page, below: Temple of the Inscriptions at Palenque, Mexico. The base of the pyramid platform held a hidden tomb containing a carved sarcophagus and offerings.

Left: Rubbing from a stela showing a high-ranking captive.

Above: Mrs. Greene beside the largest fragment of Stela 1 at Bonampak. She has nearly completed the rubbing.

Cover: Rubbing of a relief showing two ball players; the taller is holding up a human heart in offering. They are dressed in the heavy belts worn in the ceremonial ball game, which was played with a solid rubber ball.

theory that Maya culture had developed in the Guatemalan highland and spread to the lowland at the beginning of the Classic period. Another theory was that some basic ideas of Maya culture spread from the Olmec of the Gulf Coast of Mexico, who flourished before 500 B.C.

The extensive excavations of the University of Pennsylvania over the past ten years at Tikal, the greatest of the Maya cities, have changed this picture. This work has shown that Tikal was first occupied by 500 B.C., and that the core of the city had grown to 6.5 square miles by 200 B.C. Many traits leading to Classic Maya culture developed at Tikal during this Pre-Classic period from 500 B.C. to A.D. 200. These new facts suggest that Lowlands Maya culture developed in situ in the rain forest. It did not grow in isolation, for there is evidence of influence from other Pre-Classic cultures in highland Guatemala and in Mexico, which resulted in part from an active and far flung network of trade. But the patterns of Classic Maya culture were already foreshadowed at Tikal well before the beginning of the Christian era.

Included in the show are reliefs from Dzibilchaltun, Chichen Itza, Uxmal, Palenque, Yaxchilan and Bonampak in Mexico; and Tikal, Uaxactun, Piedras Negras, Kamilalijuyu, and Santa Lucia Cozumalhuapa in Guatemala.

The exhibition also includes Maya sculpture lent by the Museum of Primitive Art in New York, the Art Institute of Chicago, Mr. and Mrs. Julian Goldsmith, Mr. and Mrs. Milton W. Hitsch, Mr. and Mrs. D. Daniel Michel, and Mr. and Mrs. Raymond J. Wielgus, all of Chicago.

Above: Side of Stela 9 at Tikal, Guatemala, bearing a row of carved glyphs.

Right: Rubbing of the central figure on the Tablet of the Slaves, Palenque. This personage wears a jade necklace and elaborate ear and wrist ornaments of jade.

Right: Detail of the central figure on the sarcophagus lid shown on the preceding page. This personage, who has the idealized Maya profile, is wearing a pendant in the form of a turtle.

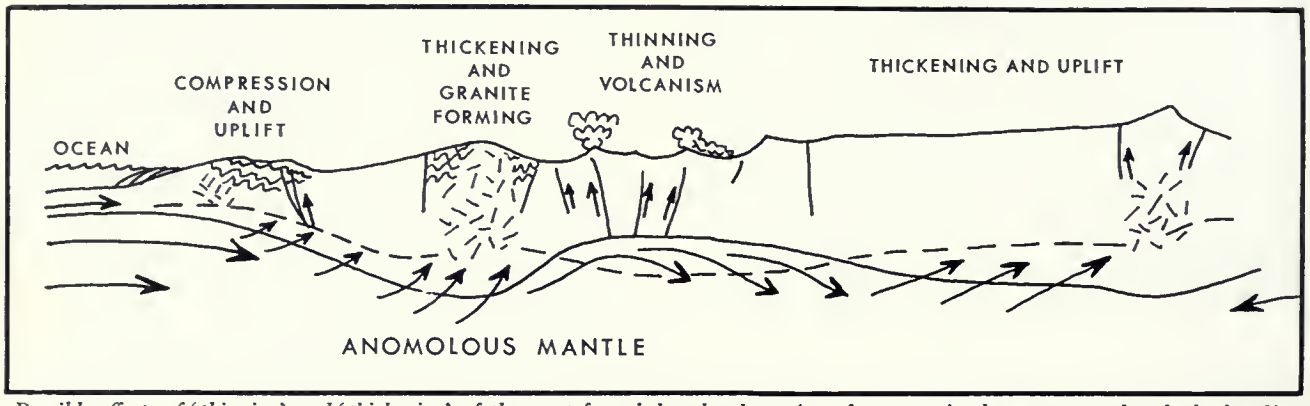
Center: Three temples at Palenque. In the center is the Temple of the Foliated Cross. A rubbing of the carved tablet in this temple is shown at the bottom.

Bottom: Rubbing of the Tablet of the Foliated Cross at Palenque. The central cross is thought to represent the "tree of life" and to symbolize the sacred corn plant. It is topped by the face of the sun god on whose head stands a quetzal bird.

mountains (*continued from p. 3*) the site of downsinking currents that virtually stopped some 80 to 100 milion years ago is also open to objections. Furthermore, much of the West has been strongly uplifted within the last 10 million years; this late vertical movement of previously uplifted and eroded mountain chains seems common. This may be related to renewed mantle current activity causing more crustal thickening after a period of isostatic adjustment.

The upper mantle beneath much of the western United States has a lower than average seismic wave velocity which is interpreted as a lower than average density. The cause of this abnormality is not known, but it is probable that it is directly related to the orogenic activity, volcanism, igneous intrusion, and uplift which has affected the area, particularly during the last 100 million years or so. One explanation is that the East Pacific Rise follows the Gulf of California and passes beneath the western portion of the United States to reappear in the Pacific off the northern California coast. The crest of the Rise is characterized by anomalous upper mantle similar to that of the western states. In addition, the block-fault mountains and basins of Nevada indicate a stretching of the crust in an east–west direction and may be likened to the central rift zone of the mid-Atlantic ridge. The vast accumulation of geologically recent volcanic products in Nevada seems compositionally to have been derived from melted sial rather than from the mantle. The heat required may be correlated with the high heat flow of rises, and the faulting of the crust provided ample opportunity for extrusion to the surface.

Against this view, however, is the evidence provided by the great African rift valleys which are, on strong grounds, regarded as the rift zone of a mantle rise, here intersecting a continent. The geological structures and the nature of the volcanism are quite different in the two areas, suggesting that there is no rise under the western United States, although some discrepancies could possibly be explained by a difference in the age of the two features. A further difficulty is that mantle currents should flow in east–west directions from a north–south rise, yet the crustal movements along the San Andreas fault zone are close to north–south. There is geological evidence that movements along the San Andreas have been immense, amounting to some 350 miles of differential displacement over the last 150 million years. The forces producing these movements were operating throughout the period when the crust of the western states was also subjected to considerable orogeny, faulting, volcanism, and igneous intrusion. As yet, we have insufficient knowledge to permit us to reconcile all these crustal events into a reasonable picture of the underlying mantle processes, or to explain the cause of the anomalous mantle. Assuming that currents in the mantle do exist, then they must have been of a complex nature beneath the western United States. It may be that more than one current may have operated simultaneously (at different levels?). Or, alternatively, an easterly flowing current may have originated in the now subsided Darwin Rise of the central Pacific, perhaps was responsible for the fault scarps of the eastern Pacific floor off California, and affected the crust of the western regions. This rise subsided some 60 to 100 million years ago, producing many guyots and atolls when the rising currents ceased. Northwest currents under the Pacific off the younger East Pacific Rise may have initiated movements on the San Andreas fault during the waning stage of the Darwin Rise currents.



Possible effects of 'thinning' and 'thickening' of the crust from below by the action of currents in the upper mantle: the broken line represents the earlier base of the crust, the lower continuous line the modified base.

Convection Currents and Continental Drift.—Currents in the mantle have also been suggested as the driving force behind continental drift. Upwelling currents beneath a continental mass and their sideways flow would disrupt the crust and move the fragments apart. The oceanic rises represent the lines along which upwellings are believed to be taking place today; the mantle currents that diverged from them in the past are considered to have caused the drifting of the continents. Paleomagnetic and other geologic evidence of drift refers to differential movement of continents and opening of the Atlantic and Indian oceans during the last 200 million years, and explains the contrasts between these oceans and the Pacific. This is the classical drift elaborated by Alfred Wegener in 1912. Just prior to this continental drift had been advocated as the cause for mountain building. It was thought that the movement of continental slabs would cause compressional buckling along the leading edges, such as the mountains of western North and South America formed by westward drift. Additionally, drift of masses toward each other would result in compressional mountain building of the opposed borders such as the Alpine mountain system formed as Africa moved northward. The forces put forward to explain the drift were proved inadequate

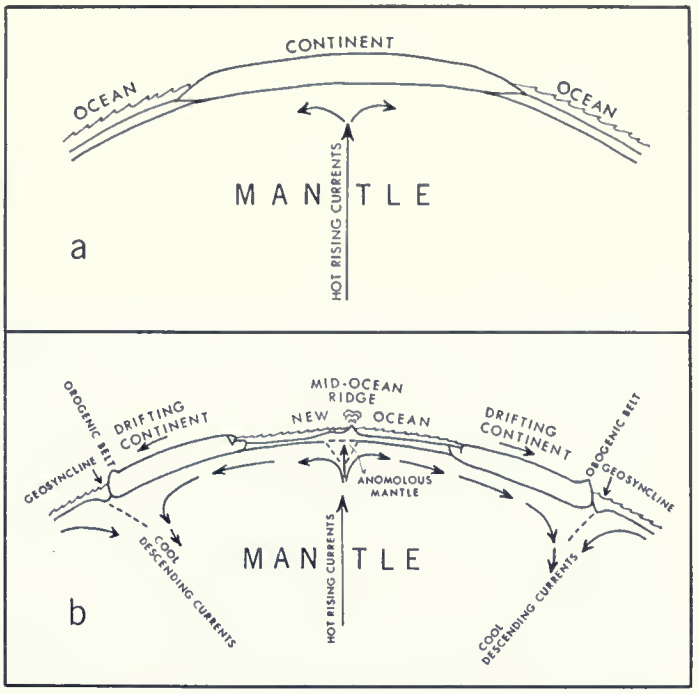
and as a result the idea of drift was generally disregarded. Also, as a mechanism for mountain building it received little support, particularly as it explained only the geologically young orogenic belts and left all the older belts, formed prior to the continental drifting, without explanation.

It is pertinent to point out here that 'polar wandering' is the name given to a concept not of displacement of the rotational axis but to displacement of the whole crust relative to the axis. This is conceived as possibly due to slipping of the crust and part of the upper mantle over the interior or else by bodily movement of the entire earth over its axis. Such adjustments may arise from instabilities in mass distributions relative to the earth's rotation which are produced by orogenesis or continental drift. It differs from the latter in that it produces no relative shift between continents. Such 'polar wandering' movements may have taken place and added their effect to that of continental drift on the displacement of the ancient poles as deduced from paleomagnetic studies. At present there is no satisfactory way of separating the effects of continental drift from those of 'polar wandering.'

The continental drift hypothesis now receives much support although the forces causing drift are still controversial. Horizontal mantle currents are favored by many, but proponents of the fundamental importance of vertical movements propose that the horizontal movements are caused by secondary gravitational sliding from primary vertical mass movements and uplifts deep within the mantle. As noted earlier, some earth scientists believe earth expansion causes separation of continental masses. Secondary distortional effects may arise from other forces, for example, the difference between the equator and the poles in speed of rotation of the crust around the earth's axis. However, the amount of expansion required to form the Atlantic and Indian oceans is too great. Mantle currents seem to be the best available motive force for drift.

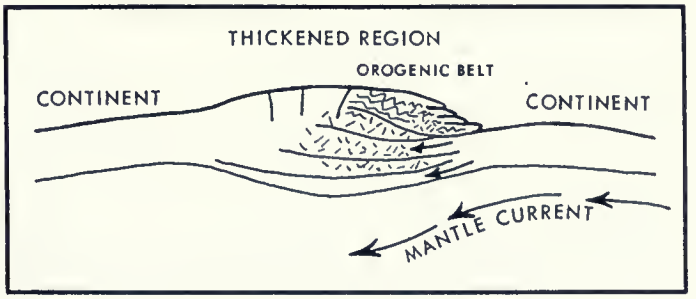
Compressional structures may arise by distortional movements of one crustal segment in relation to another, and crustal thickening may result when one crustal block rides over or under another. The high Tibetan Plateau may represent such a double thickness of crust. However, orogenesis, with all its attendant phenomena of deposition, deformation, metamorphism, volcanism, and igneous intrusion, is generally not so directly related to drift. Rather, it depends on the operation of mantle currents causing specific effects other than passive transport of crustal slabs; for example, the downturning zone of a current may be related to the subsidence of a geosyncline and the subsequent deformation of its sedimentary fill.

Sources of Energy.—The source of energy driving the proposed mantle currents is not known. Some believe that physical and chemical changes take place in the mantle in the earth's gravitational field and more dense and less dense fractions are produced which result in mass movements—the denser sinking, the lighter rising. The more generally accepted theory is that the currents are the result of heat production, which gives rise to excessive heat gradients, which, in turn, cause flow of inner hot material toward the cooler outer zones and the return of cooler, denser material to the interior.



Above: *Shows continental drift, mid-ocean ridges, and compressional orogenic belts resulting from convection currents in the mantle; a) initial stage of currents ascending beneath continent; b) mature stage, continents drifting and new ocean formed.*

Below: *Thickening of crust by underthrusting of one continent by another under the influence of mantle currents; thickening may also be caused by compression.*



Such convectional movements can be likened to the overturn of the syrup during the making of preserves or to the movement of air masses in the atmosphere which gives us our weather. A source of heat in the mantle is the decay of radioactive elements. This is probably inadequate so that an additional source is required. It is conjectured that this may be related to the growth of the core, a process which would release gravitational energy as heat.

Alternatively, the change in state of dense metallic core material to mantle material, as discussed earlier, would release much energy as heat as well as cause a volume increase. In this respect it is interesting to note that, based on their average densities and absence of magnetic fields, neither the moon nor Mars seems to have a core in the sense that the earth does. Their surface features, revealed to us in more detail than ever before by the photographs radioed back by the Ranger and Mariner space vehicles, are quite different from those of earth. Craters and other features seem best explained by meteoritic bombardment and a form of vol-

canism. Mountain building similar to that on earth is absent. One conclusion is that there are probably no convection currents in the moon or Mars. Radioactivity produces some internal heating, perhaps, to support some volcanism, but these two bodies may be cooling now, rather than warming up. The absence of oceans and the virtual absence of an atmosphere on the moon and Mars means that sedimentary depositional processes, as we know them on the earth, and thus the development of geosynclines, are impossible on these bodies. Venus has sufficient mass and average density to have a core, but perhaps not to have an inner core like the earth does. The absence of a Venusian magnetic field (as recorded by a space vehicle) may be the result of the lack of reactions related to an inner core. However, the core of Venus may have been, and may still be, subject to changes like the earth's outer core, and the energy released may have produced convection currents, with the result that the surface of this planet may have mountain ranges like the earth.

It is still only conjecture that the earth's mantle has convection currents. On the whole, they seem to be the best available driving force for both orogenesis and horizontal displacements of the crust. One serious objection that has been raised against the currents is the seismic discontinuities in the mantle, particularly the one between the upper and lower mantle at a depth of about 600 miles. It is argued that, if change of chemical composition is the cause of the discontinuity, the preservation of the discontinuity is a barrier to convection currents, as these would cause mixing. Separate convection systems may still operate above and below the discontinuity and, while the former may be large enough to cause orogenesis, it seems unlikely they would be on a large enough scale to cause continental drift. However, if the discontinuity is produced by a physical change of mantle material due to increasing pressure, then the currents may pass through it. The movement would be slow enough so that the material could change as it is carried upward, thus preserving the seismic discontinuity. Possibly these physical changes in the upper mantle may be related to the origin of deep earthquake shocks. Assuming that currents do exist, there are many problems in trying to work out their present form and distribution so as to explain all the crustal features of oceanic rises, trenches, heat flow, volcanism, earthquakes, and horizontal and vertical movements. Some of these phenomena may, in any case, have only an indirect relationship to mantle currents, e.g., volcanism of the Central Pacific and isostatic response to loading or unloading of the crust.

Summary

At the present time, then, the action of convection currents in the mantle, driven by changes in the interior of the earth which release energy, is the favored mechanism for mountain building. We have seen, however, that the operation of other fundamental forces such as rotation of the earth, gravity, buoyancy, isostasy and contraction or expansion all influence the evolution of crustal structures. In particular, the secondary gravitational effects produced by primary vertical uplift are undoubtedly important in the development of folding and thrusting structures that were formerly explained by tangential pressures. However, it seems to me that the complex folding and metamorphism exposed in what were the deep-seated cores of old orogenic zones require primary compressional forces which are most easily derived by the action of convection currents in the upper mantle. Additionally, evidence of large horizontal crustal movements and acceptance of continental drift demand mantle currents.

The source of energy to drive the currents seems to depend on something more than radioactive decay, and this may be evolutionary change deep within earth. It has been suggested that, if the core has grown throughout the earth's history, its changing size would have caused periodic fundamental changes of the main mantle convection from an early single circuit or cell to a multi-celled form. The change in cell number, size, and distribution may initiate continental drift with attendant fragmentation, if currents arise below a continent, or accretion if two continents are driven toward each other. This may have occurred several times since the origin of the earth and may have been accompanied by great basaltic outpourings, such as flooded parts of India, Brazil, South Africa, Greenland, Iceland, etc., when the Atlantic and Indian Oceans were formed. Such events, against a background of slow earth contraction or expansion, may be responsible for the major cycles of orogenic activity discernible in the radioactive dating of igneous and metamorphic rocks throughout the world.

Mountain building is not only a phenomenon of the past but is actually going on today. The beds of canals built some 1700 years ago in Persia have been uplifted (as much as 60 feet in one case) so that water would now no longer flow in the original direction. Metamorphism is probably proceeding at great depths beneath some of the youngest folded zones associated with volcanic arcs.

It is obvious from the number of opposing theories that we have much yet to learn about the inner workings of our planet, its past history, and in particular about mountain building. We still do not have a satisfactory synthesis of the causes of all the phenomena connected with mountain building nor do we fully understand the mechanics of rock deformation, the origin of earthquakes, and the development of major structures such as rift valleys. However, our knowledge is increasing at a great rate and it is certain that continued geological studies in the field and laboratory will solve many of the outstanding problems. (*Continued on page 12*)

So many sources were used for the writing of the articles on mountain building that it was not possible to refer to them in the limited space of the Bulletin. Some of the more important ones were written by the following authors:

Beloussov, V. V.; van Bemmelen, R. W.; Bucher, W. H.; Carey, S. W.; Chadwick, P.; Dearnley, R.; Dietz, R. S.; Egyed, L.; Engel, A. E. J.; Fisher, R. L. and Hess, H. H.; Fitch, F. J. and Miller, J. A.; Gilluly, J.; Holmes, A.; Orowan, C.; Lyttleton, R. A.; Pakiser, L. C.; Ramberg, H.; Scheidegger, A. E.; Sutton, J.; Thompson, G. A. and Talwani, M.; Umbgrove, J. H. F.; Vening Meinesz, F. A.; Wilson, J. T.

(A selected bibliography is available on request from the author of the articles.)

AN AQUATIC? MARVEL– THE BASILISK

by Hymen Marx, Associate Curator, Reptiles and Amphibians

As the sun slowly set into the west, we set out to observe and collect the basilisk. The basilisk is a fascinating reptile, whose claim to fame is its ability to run over the surface of water. Literally running on its hind feet, dinosaur-like, it scampers over the water at the rapid rate of 5 or 6 miles (or knots?) per hour. Whatever the rate may be, it is a sight to behold! It is always thrilling to see a large male basilisk almost three feet long, with all its frills, running on its hind limbs at full speed on the surface. For those who feel that nature has not equated the sexes, sex is no hindrance as far as running is concerned. The females (and young) run just as fast as the males.

As part of may recent trip to observe Central American tropics, I observed and measured the rate of speed of these lizards. A remarkably appropriate site to study tropical environment and many of its component units, is Barro Colorado Island. This island in the Canal Zone is a research station of the Smithsonian Institution. Here many scientists of many disciplines—environmental, systematic, behavioral, experts to mention a few—take the opportunity to study all sorts of undisturbed life. At this very island some of the critical pioneering research took place because men had access to the animals and plants of the rain forest for relatively long, uninterrupted periods of time. At Barro Colorado Island primate and insect behavioral studies, for instance, have led to many important and fundamental discoveries. While I was on the island Dr. T. S. Schneirla was there continuing his research on the behavior of army ants. The support of so important a research center as Barro Colorado Island, and its like, cannot be overemphasized or underestimated.

Author Hy Marx holds a male basilisk preparatory to its take-off over water's surface.

Anyway, back at the canoe, resident zoologist Dr. A. Stanley Rand and I set out to collect live basilisk. The best time is at night when the animals are asleep in the branches of trees overhanging the shore. To collect live basilisk during the day is nearly impossible because of their striking alertness. They will take off at full bipedal gallop over land or water at the nearing of danger. And we were the "danger."

We set out in our canoe at dusk, head lamps and collect- (*Continued on page 12*)

CALENDER OF MAY EVENTS

May 7 – June 27 MAYA ART, RUBBINGS FROM STONE CARVINGS
Special exhibition of 43 ink rubbings made from Maya reliefs plus a loan collection of Maya sculpture. *Hall 9 Gallery.*

May 21 CHICAGO AREA TEACHERS' SCIENCE ASSOCIATION FAIR
Students from Chicago and suburban public, private and parochial schools exhibit and explain prize-winning science projects. *Stanley Field Hall.*

May 23 – June 20 BIRDS, BEASTS AND MUMMERY
Display of drawings, paintings, and sculpture about the Museum and its exhibits. By students of the Junior School of the Art Institute. *Stanley Field Hall.*

June 1 – June 30 16TH ANNUAL AMATEUR HANDCRAFTED GEM AND JEWELRY COMPETITIVE EXHIBITION
The Chicago Lapidary Club shows over 100 prize-winning examples of cut gems, jewelry incorporating polished stones, and stone and polished slab collections. *Stanley Field Hall.*

MAY MEETINGS

OPEN TO INTERESTED PERSONS

NATURE CAMERA CLUB OF CHICAGO, May 10 at :30 P.M.
ILLINOIS ORCHID SOCIETY, May 15 at 2:00 P.M,
STATE MICROSCOPICAL SOCIETY OF ILLINOIS. May 17 at 7:30 P.M.
CHICAGO SHELL CLUB, May 22 at 2:00 P.M.

AQUATIC? MARVEL (*continued from page 11*)

ing sacks at hand, toward a shore line with many overhanging trees. We paddled along the jungle's edge as darkness set in; the beauty of the overall scenery was breath-taking. But as we approached the overhanging vegetation we were diverted from this natural beauty by our search for sleeping lizards in the foliage. The lizard looks very much like its surroundings: the long and slender tail has brown and tan bands and hangs limply from its anchorage, the body. We often grabbed vines with lichen blotches growing on them which made them look like the tail bands of the basilisk. But I must also do justice to the camouflaging adaptation of the rest of the animal. It is extremely well hidden, looking like part of the branch on which it is perched and sleeping.

When a basilisk was spotted we slowly paddled or drifted close to the lizard and attempted to seize it. If seizure was successful the only problem was who would get hurt, Stan or myself. Certainly not the lizard. Its bite is to be avoided, for it bites hard and firm, and the jaws tend not to let go. In fact, they do not let go. Who gets bitten, depends on who is closest to the perched lizard and, consequently, has the privilege of seizing the animal. But blood rarely flowed from the captor's finger so we collected a good many samples of these fascinating reptiles.

If we missed the basilisk by shaking the branches or by an inaccurate swipe at it, the animal jumped into the water—no, not into, but on top of the water—and speedily sprinted to the shore or some distant log. A fine example of an escape mechanism—bite, jump, and/or run.

This opportunity to see and study the basilisk, day and night, in its natural habitat, will long be remembered. And to have so adequate a place to do our work as Barro Colorado Island will always be appreciated.

mountains (*continued from page 10*)

Geophysical research into the nature and behavior of the mantle and core will refine our ideas of the driving forces of crustal evolution. Deep drilling in the continental and oceanic crust will provide us with samples and data not now available. The Mohole project, now being actively worked on, to drill right through the crust will provide us with samples not only of the oceanic crust but of the upper mantle, below the Moho discontinuity. Experimental reproduction of the effect of stresses on replicas of crustal and sub-crustal materials will be an important additional source of knowledge. Exploration of the moon and near planets will also enable us to compare their evolution with that of the earth and perhaps help us to arrive at a more fundamental understanding of the inner workings of the earth. In all these ways we shall gradually solve some, at least, of the problems of our earth's history and the evolution of its crust.

FIELD MUSEUM OF NATURAL HISTORY
Roosevelt Rd. & Lake Shore Drive
Chicago, Illinois 60605
Founded by Marshall Field, 1893

BOARD OF TRUSTEES
Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
Walter J. Cummings
Joseph N. Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Edward Byron Smith
Louis Ware
E. Leland Webber
J. Howard Wood

HONORARY TRUSTEE
William V. Kahler

OFFICERS
James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM
E. Leland Webber

CHIEF CURATORS
Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Kathleen Wolff, Associate Editors

STORY MUSEUM

Volume 37, Number 6 June, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

Go To The Ant

by John Clark, Curator, Sedimentary Petrology

We know very much less about modern mammal communities than one might suppose. Actually, no one has ever determined how to take a complete census of the mammals of one community. Suppose, for instance, that we wanted to count all the animals within the home range of a single rhinoceros. He might roam over two square miles, but a mere hundred yards of his range would overlap that of an even wider-ranging giraffe. Would you then count the giraffe? And would you count all the generations of mice and rabbits who shared the rhino's home acres during his much longer life span?

However, museum collections of fossil vertebrates reveal a problem because proportions differ from those of actual mammal communities. Usually a collection has more animals cat-size and larger than it has rat-size and smaller. Why? We know that small bones are preserved just as readily as large ones, so only one explanation is possible. The small bones are present, but collectors aren't finding them. Anyone who has crawled over a Wyoming badland flat on a blistering summer day, with gnats biting his ears and sweat in his eyes, trying to find fossil mouse teeth among a surface rubble of small pebbles, clay pellets, and dried sage leaves, knows why we overlook most of the small teeth.

Many years ago, paleontologists noticed that humans may have trouble finding small fossil teeth, but ants do not.* The ants pick up any pebbles, including fossil teeth and bones, small enough for them to move, and place them on their nest or ant-hill. By scraping off this protective layer of grit and sorting it, one gets a sample of all the small objects within about fifty yards of the ant-hill. Fine collections have been made with the unwilling cooperation of the ants. It has always been assumed that the ants would pick things up at random, giving us a fair sample of everything. But last summer I began to wonder about ants.

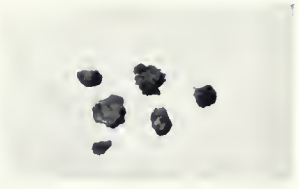
One day in South Dakota, my assistant and I were walking across a creamy-white gravel flat when we noticed a bright pink ant-hill rising from it. We looked closer, and found that over half of the grains of the ant-hill were small garnets! I hurried over to a fresh gravel exposure and scooped up a heap of ant-sized grains. About one in a hundred was a garnet. The ants had certainly shown a marked preference for garnets. But why did they like them? Did they like the color, or the heavy weight, or the almost-round shape, or the surface texture?

A few days later we were prospecting over hills of bare, black shale. A quarter-mile away, we saw two strange masses glistening in the sun like piles of broken glass. When we approached them, we found ant-hills again. This time the ants had chosen glassy, lath-shaped crystals of selenite gypsum three-fourths of an inch long, as big as they could carry. Plenty of tiny gray or brown limy nodules, almost round and much more conveniently sized, were equally available but almost unused. Once more, were the ants interested in color, or size, or shape, or weight?

Whatever may be an ant's basis for selection, it is apparent that he has one. He has very definite preferences, and doesn't simply pick up grains at random.

We can probably trust the ants to give us a fair qualitative sample of whatever small teeth lie near their nests, because their bias is not absolute. They do pick up some of the particles which are less preferred. But suppose that an ant prefers a lath-shaped selenite crystal, like the one in the illustration, to a roundish calcite nodule. Would he then also prefer a lath-shaped fossil rabbit tooth, like the one shown, to a roundish fossil squirrel tooth? No one knows except the ant.

We cannot, therefore, trust the ants to give us a numerically valid sample of a fossil small-animal population. Before we can use the ant-hill collection statistically, we must go to the ant, consider his ways, evaluate his biases, and respect his prejudices. But how in the world does one commune with an ant?



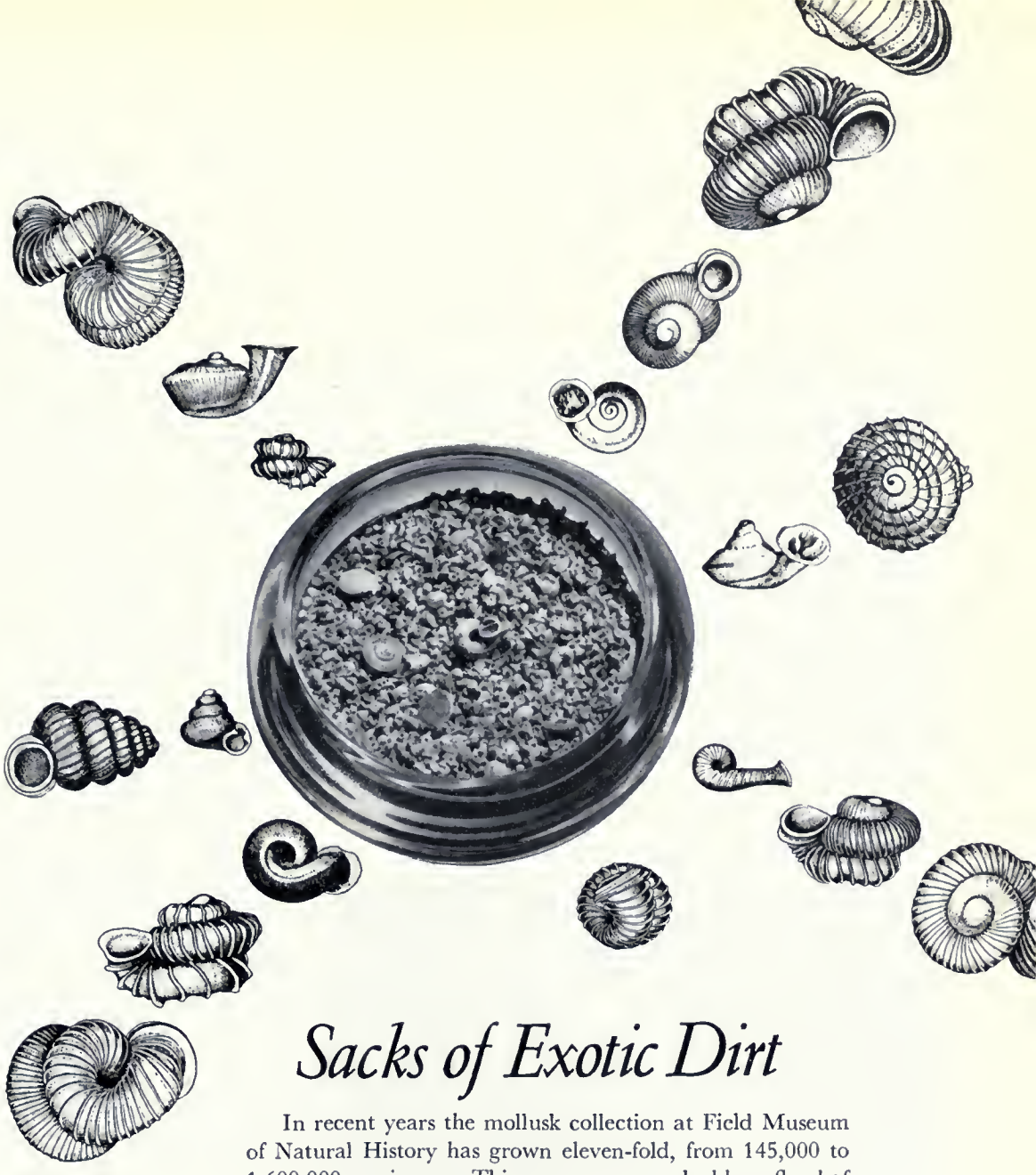
◂ With these concretions available,

the ants chose these selenite crystals. ▸

◂ With this round squirrel tooth available

would the ants prefer this long rabbit tooth? ▸

* See "Ant Hill Colony Assists Fossil Collectors in Wyoming," by W. D. Turnbull, in the Bulletin, September, 1959 (vol. 30, no. 9).



Sacks of Exotic Dirt

by Alan Solem, Curator, Lower Invertebrates

Above: A watch glass holds the thousands of snails culled from one bag of dirt.

In recent years the mollusk collection at Field Museum of Natural History has grown eleven-fold, from 145,000 to 1,600,000 specimens. This process was marked by a flood of packages and cartons which have variously floored, awed, disgusted or delighted a series of part-time volunteers and student helpers. Even the U. S. Customs has become accustomed to the arrival of odoriferous boxes containing recently dead snails from distant lands. Personal notes from plant and animal quarantine inspectors are now tucked into the opened boxes, replacing the previous telephone summonses to O'Hare Field.

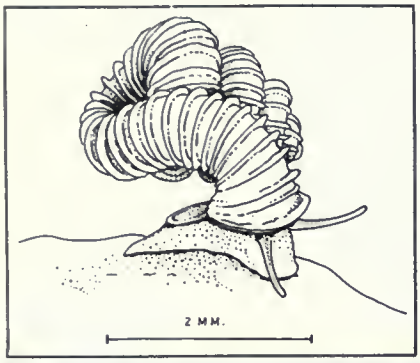
The enthusiasm of Dr. Fritz Haas and myself over an Indonesian shipment of limp, slime-coated slugs in discolored alcohol, or a very ripe box of obviously recently deceased snails from Colombia invariably means more work for our helpers. Each new shipment requires sorting, housing, labeling, cataloging and storing of the identified shells in the main collection. Hence the arrival early in 1964 of a small box from North Borneo provoked no special notice, until the contents were revealed as several bags of dirt.

Two years and many student assistants later, most of the dirt has been sifted and sorted into two piles: a) thousands of tiny snails, and b) just plain dirt. Most of the specimens

from a single bag can be held in a watch glass, since the adult shells are only one to three millimeters in size. Actual specimens are dwarfed by a penny and seem inconsequential, but are fantastically varied in shape and sculpture. They are part of probably the richest and most varied land snail fauna existing today.

Throughout Southeast Asia and some parts of Indonesia, isolated limestone hills rise from floodplains or rolling regions of non-calcareous rocks. Away from the limestone, snails are scarce, but at the base of the limestone hills, snails are everywhere. Restricted as they are to the hills by their need for calcium, a multitude of species and races have evolved. Only now are they beginning to be recognized and described by scientists.

The first scattered individuals were collected in the 1860's,



◀ Dr. A. J. Berry's drawing of *Opisthostoma* crawling.

Gyliotracheta depressispira photographed on a millimeter ruler. ▼

but until M. W. F. Tweedie began systematically to explore the limestone hills of Malaya, we had no idea of the fantastic variety and abundance of these species. Quite soon a simple collecting technique was developed: Find a limestone hill. Walk around part of it until you see an area of exposed limestone blocks. Hunt for accumulated debris at the base of the exposed blocks. A quick look at a handful of dirt tells whether the minute empty shells are present. If they are, bag a quantity of the dirt, dry it, and send it off for sorting. One bag is enough to keep a student busy at a microscope for many days!

After Tweedie had done the initial exploration and collecting, Mrs. W. S. S. van Benthem-Jutting van der Feen in Amsterdam studied and described the many species. Illustrations of several species from her technical reports are shown on the preceding page. The first stage in study, learning of their presence and that they are usually confined to a single hill, was soon accomplished. Then it was possible to investigate matters more biologically interesting. Bagged dead shells tell little about a species. Where do they live on the hills? How long do they live? What do they feed on? Innumerable questions are possible.

Only recently have any answers been found. Dr. A. J. Berry of the University of Malaya has spent the last several years studying the ecology and life history of several species found on Bukit Chintamani, a small hill near Bentong, Pahang, Malaysia. Comments here are restricted to two minute genera—*Opisthostoma* with its fine ribs and totally reversed aperture and *Gyliotrachela* with its triangular form and trumpet-shaped aperture. Both are less than one-eighth inch in size and very difficult to spot unless you know where to look. But on nearly bare limestone faces with only a scattering of fine mosses and lichens, usually in a shaded spot, these snails are almost incredibly abundant. *Opisthostoma* will be found among the moss filaments, while *Gyliotrachela* is usually on the bare rock surface where lichens occur only in scattered masses. Dr. Berry's picture (below, left) of *Gyliotrachela depressispira* on a millimeter ruler shows the typical position of the resting snail shell. When young, the animal crawls in a normal snail-like position, but the peculiar last growth stages turn the shell upside down.

Opisthostoma can only be described as growing wildly. Species of *Opisthostoma* are now known to grow by adding a stretch of shell and one rib each day, reaching adult size in 110–124 days. The peculiar upward turning of the last whorl happens within the last 15–23 days of growth. Photographs of the *Opisthostoma* are almost impossible to get. The drawing of *Opisthostoma* crawling was made by Dr. Berry.

While Malaya has been moderately well collected, other parts of Southeast Asia and Borneo represent almost totally unknown areas in terms of the land snails. Cambodia and Viet Nam, Sarawak and Sabah, Indonesian Borneo and parts of Thailand, all have areas with geology that is similar to the Malayan limestone hill country. To date we have only tantalizing fragments of collections from a very few hills in these regions. Hence the chance to obtain collections (i.e., bags of dirt) from hills in Sabah was eagerly seized upon by the scientists in the Division of Lower Invertebrates. Although the reaction of the dirt sorters has not been recorded, it undoubtedly carried a lower level of enthusiasm.

While dirt and snails are now separated, the snails still have to be sorted into species, studied, and, if they prove to be new to science, named and described. Even then, only parts of a few more hills will have been sampled, and crudely at that. Currently my Bornean "dirt-bagger" has moved to Malaya. We have no "dirt-baggers" in Viet Nam or the other areas, and would welcome such workers.

Even with the active cooperation of "dirt-baggers" and "dirt-sorters," it will take many bags of dirt and hundreds of sorting hours at many museums before even the preliminary survey of what lives where will be completed. By accumulating material from these poorly-known areas for study by scientists, Field Museum of Natural History is making an important contribution to surveying the world's snail fauna.

MEMBERS' NIGHT REPORT

Increasing Museum activity climaxed by the preview of Maya rubbings brought out a record attendance of 3,000 on May 6. *Upper left,* Brenda Harter and Herbert Quist admire herbarium ferns. *Lower left,* youngest member, six-month-old John Erwood, Jr., sleeps. *Below,* Darlene and Herbert Kofink and Mr. and Mrs. Robert Faurot view rubbing of Maya sarcophagus lid from Palenque, Mexico.

Taxidermist Carl Cotton answers questions, *upper left,* of Mr. and Mrs. Herbert Barsy, about iguanas. *Upper right,* Mr. and Mrs. Albert S. Lincoln and son Steven, join hundreds around punchbowls. Crab-eating monkey, *below left,* is pointed out by Charles Schwartz to son Ned. *Below right,* Dr. William Berger chats after his lecture with Thomas Kneebone and Mr. and Mrs. Torkel Korling, while *at right,* Barbara Hutchins contemplates an orang.

Putting together the pieces

by Paul Martin, Chief Curator Emeritus, Anthropology

ARCHAEOLOGISTS study the behavior—that is, the customs and manners—of peoples who lived long ago. The terms *customs* and *manners* cover a variety of items, such as ceremonies, trade, social life, ways of doing things, fashions. By extension, these terms have come to mean house types, village layouts, kinds of pottery, varieties of food, kinds of stone and bone tools, methods of weaving and basket-making. Most of these particulars may be grouped under three broad headings: technological (ways of coping with one's environment); sociological (ways in which men group themselves with one another for dealings with one another); and ideological (modes of thinking, and hence ceremony, religion, philosophy).

In other words, archaeologists try to reconstruct as much as possible of the total life ways of a particular people—people who lived perhaps hundreds of years ago or even tens of thousands of years ago. In order to establish a correct sequence of events they must have a clear idea of when a people (site or town) flourished. Chronology, then, is an important adjunct of archaeology.

This is a large order and archeologists often find it difficult to interpret the results of their excavations. On the whole, a modest success can be claimed for their efforts.

A generation ago, American archaeologists were concerned about the origin of the American Indians (Asia); how long ago they moved into the New World (about 10,000–40,000 years ago); and how they got here (probably on foot via a land bridge connecting Siberia and Alaska). These are merely questions of "where" and "when."

Building on the solutions to these basic questions, we progress to further queries such as "how" and "why." In other words, now that we know so much about the past history of the Indians, particularly in the American Southwest, we can proceed to more delicate and subtle questions, such as why the Indians of the Southwest made and used ceramic containers while their California cousins did not? or, why did the Indians abandon large parts of the Southwest after A.D. 1200? or, why did the Pueblo Indians adopt a social organization which reckons descent through the mother-line, requiring a husband to make his home with his mother-in-law?

We may not now be able to answer these questions; but unless we ask them we shall certainly *never* arrive at answers.

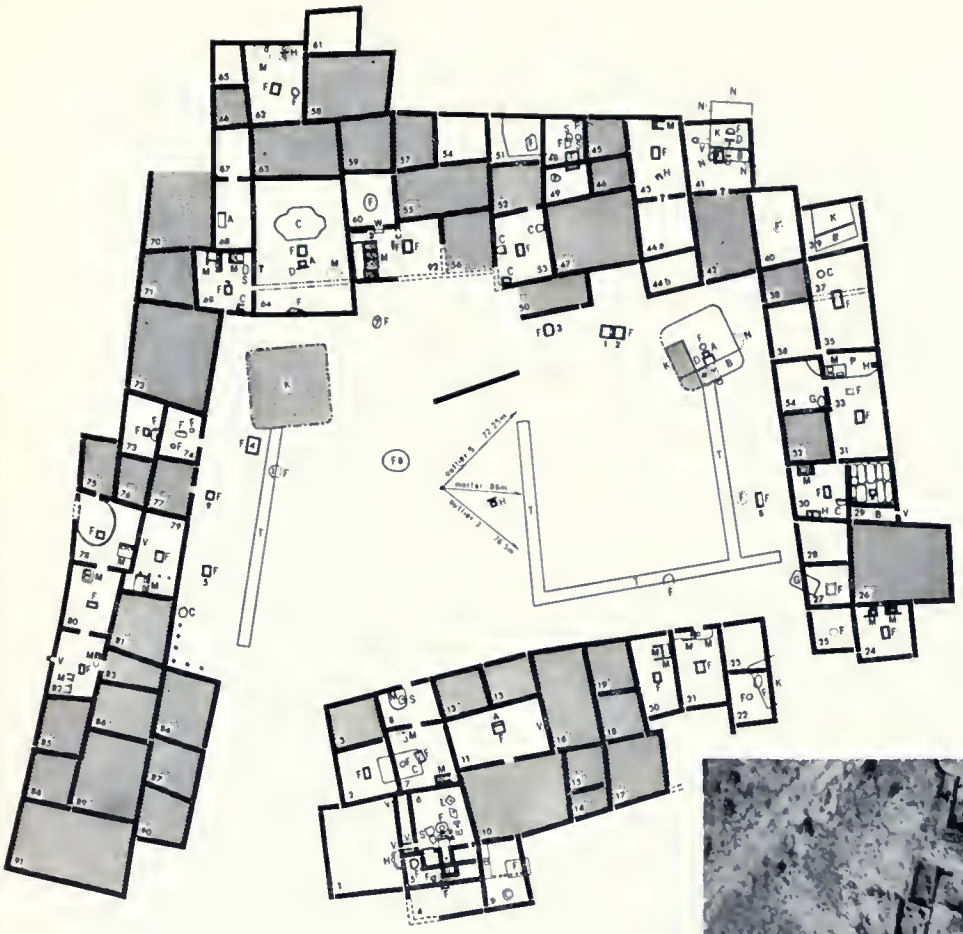
I shall not discuss here the technical aspects of recovering cultural debris. Careful sampling, plus painstaking analysis of all materials found are absolute prerequisites. The material recovered may include tools of stone and bone, whole and broken pottery vessels, remains of houses and fire-pits, milling stones, unworked animal bones, charcoal and wooden roof beams, seeds and food remains, basketry and matting, and samples of dirt from floors of rooms, from fire-pits, and from storage-pits.

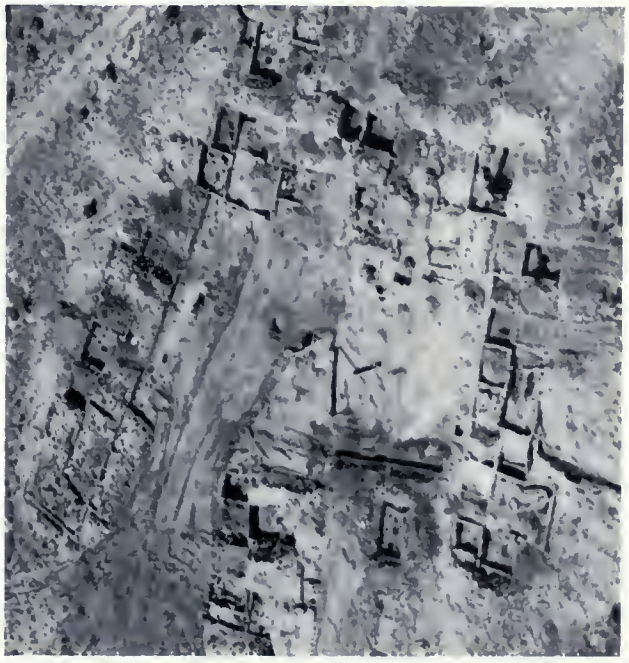
We use charcoal or roof beams for extracting tree-ring or radio-carbon dates. Samples of dirt are processed to obtain pollen which may have been preserved for millions of years. From that we can make firm statements about past climates and plant life and about foods gathered and eaten. Animal bones will tell us what mammals were hunted for food.

Let me cite a few examples of how all these miscellaneous facts were combined to reconstitute the life ways—the characteristics of the social system as well as the technological aspects of the culture of one village. The village is located near a now dry stream in eastern Arizona and bears the name of Broken K Pueblo. Broken K is the brand mark of Mr. James Carter, who owns the ranch on which we found the site. Broken K Pueblo is located in Hay Hollow Valley, a small valley which was drained by a minor tributary of the Little Colorado River, Hay Hollow Wash.

The pueblo consisted of about 100 one-story contiguous rooms built around a hollow square—a plaza. Some rooms (small and featureless) were for food storage; other larger ones containing fire-pits, fresh air vents, built-in corn-grinding apparatus and work-pits were living quarters. Some parts of the pueblo antedate others. When girls married, their husbands joined the girls' families, and more contiguous rooms were added. Women made the pottery, the baskets and the milling stones, plastered the rooms, prepared the meals and probably tanned the hides. Men built the houses, wove textiles of cotton, hair or fur, planted and harvested the corn, beans and squash. They made the projectile points and other stone tools, and performed religious ceremonies in specially built rooms called kivas.

The pueblo was founded about A.D. 1150 at which time large animals were abundant (antelope, deer, mountain sheep) and rainfall was adequate for producing crops. About A.D. 1250, a slight shift took place in the pattern and amount of snow and rainfall. In other words, the climate worsened for the growing and harvesting of crops. The population declined somewhat, large quantities of seed corn had to be set





Right: An aerial view of the Broken K site. *Above:* A detailed floor plan of the same site. Shaded rooms are not excavated. The site was discovered by Dr. William A. Longacre during a survey in 1961–62 and excavated in the summer of 1963 by the Southwestern Archaeological Expedition of Field Museum. The area around the pueblo is a gently rolling plateau, badly eroded by over-grazing and high winds; it is cut by numerous arroyos, dry most of the time, swift-running and destructive after rains. Sparse grass, amarinth and stunted junipers are the most common plants. The area is bleak, dreary and uninviting.

aside for use during and after bad years. Quantities of wild food-plants were gathered and stored (walnuts, piñon nuts, seeds, roots, bulbs) and more cooperation and integration were necessary to keep the townspeople together. Some of the rooms were abandoned toward the end of the life of the village although no one wing or section was forsaken.

Ceremonial life may have become communal instead of being left in the hands of the males, since the kivas seemed to have been left untended. The plaza may have been used for highly sanctified rain-making rites and other ceremonies that may have become frantic because of desperation.

Eventually, the struggle became too much and the elders decided, about A.D. 1385, to abandon their village. It was the last town to have been occupied in the whole valley. The people may have moved about 15 miles westward and merged with another town more fortunately located on a still running stream.

Broken K Pueblo was the climax of 18 centuries or more of cultural development in Hay Hollow Valley. For a number of years we have been piecing together this development. Our earliest site (County Road) dates to at least 500 B.C. The Carter Ranch Pueblo lasted roughly from 950 to 1150 A.D. and Broken K until near the end of the fourteenth century. By concentrating our efforts in a small geographic area, over a very great span of time, we hope to achieve a sense of both the continuity and the change in social history.

FIELD MUSEUM AWARDED SHINNER FOUNDATION GRANT

A $9,000 GRANT has been awarded the Museum by the Ernest G. Shinner Foundation to provide college students interested in the natural sciences with positions in the Museum's scientific departments during the summer vacation. The grant will give students working toward degrees in biology, geology or anthropology a unique opportunity to broaden their knowledge of their field of study and to learn first-hand the operations of a great research center. The museum experience will also allow the students to assess career interests in the sciences at a particularly vital stage in their education.

This grant continues a long-standing Museum program of student assistance, a program that has seen many of its participants go on to significant roles in scientific research.

PUBLIC RELATIONS COUNSEL PHIL CLARK JOINS STAFF

APPOINTMENT OF PHIL CLARK, formerly of the New York Botanical Garden, as public relations counsel of the Field Museum of Natural History has been announced by E. Leland Webber, director of the Museum.

Mr. Clark headed the public relations and membership departments of the New York Botanical Garden for the past four years and planned and directed a fall, 1965, tour of Guatemala as a membership activity for that institution.

Before going to New York, Mr. Clark was for ten years garden editor and Sunday editor of *The News*, Mexico's English language daily newspaper, and resided in Mexico. He continues to write the garden page of *The News* and his articles on gardening and Mexican plants have appeared in numerous United States, British and Mexican publications. He has also served as the editor of *Horticulture*, as garden editor of *Living for Young Homemakers*, and as a feature writer for the *San Antonio Express* and the *West Central Minnesota Daily Tribune*. Mr. Clark is a native of St. Cloud, Minnesota, and a graduate of the University of Minnesota.

"THE 'EYES' HAVE IT"—NEW SUMMER JOURNEY

CHILDREN WILL HAVE a chance to act as "private eyes" this summer when they take the new Museum Journey, "The 'Eyes' Have It." On this self-guided tour, boys and girls will seek clues in Museum exhibits to uncover much in the world of nature which remains hidden to all except those who really learn to use their eyes.

Unlike past Journeys, children will not need to read exhibit labels to answer the questionnaire accompanying the Journey, but instead they must use "the magnifying glass" of their minds and find the answers in the exhibits themselves. Youngsters taking the new summer Journey will find an exciting world of color, form and story hidden in nature.

Tour directions and the Journey questionnaire for "The 'Eyes' Have It" may be obtained at the Museum entrances, or at the Information Desk; the questionnaires, when completed, should be deposited in the barrels provided at either entrance. Awards for successful completion of four Journeys, or multiples of four, are given at special ceremonies in the Museum each spring. The new summer Journey is available from June through August.

CALENDAR OF JUNE EVENTS

through June 27 MAYA ART, RUBBINGS FROM STONE CARVINGS
Special exhibition of 43 ink rubbings made from Maya reliefs plus a loan collection of Maya sculpture. Hall 9 Gallery.

through June 20 BIRDS, BEASTS AND MUMMERY
Display of drawings, paintings, and sculpture about the Museum and its exhibits. By students of the Junior School of the Art Institute. Stanley Field Hall.

June 1-30 16TH AMATEUR HANDCRAFTED GEM AND JEWELRY COMPETITIVE EXHIBITION
The Chicago Lapidary Club shows over 100 prize-winning examples of cut gems, jewelry incorporating polished stone, and stone and polished slab collections in its annual show at the Museum. Stanley Field Hall.

JUNE MEETINGS STATE MICROSCOPICAL SOCIETY OF ILLINOIS June 16 at 7:30 P.M.
open to members and interested non-members

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT RD. AT LAKE SHORE DR.
CHICAGO, ILLINOIS 60605
Founded by Marshall Field, 1893

BOARD OF TRUSTEES
Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
Walter J. Cummings
Joseph N. Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Edward Byron Smith
Louis Ware
E. Leland Webber
J. Howard Wood

HONORARY TRUSTEE
William V. Kahler

OFFICERS
James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM
E. Leland Webber

CHIEF CURATORS
Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Kathleen Wolff, Associate Editors

COVER: *A group of paper cut-out flowers made by the young students at the Junior School of the Art Institute. They are on display in the School's Annual Show at the Museum, in June.*

Volume 37, Number 7 July, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

WOMEN'S BOARD Inaugurated at Museum

AN ENTIRE NEW DIMENSION of service will be brought to Field Museum by its newly-organized Women's Board which was inaugurated at a luncheon in late May and whose first function will be a tea for Chicago's consular corps on July 12.

The consular event, for the nearly 50 foreign delegations which serve the area, will feature presentation of special Field Museum Memberships to the consuls. Mrs. Hermon Dunlap Smith, Board Chairman, Mrs. W. H. Arnold, Tea Committee Chairman, James L. Palmer, Museum President, and E. Leland Webber, Director, are program participants.

Hostessing special events, welcoming distinguished visitors and drawing the community closer to the Museum are only a part of the functions of the new organization. It will also prepare women to serve as volunteers in the Museum's scientific and educational work. Looking toward this volunteer role, the 85 women who attended the charter luncheon and the 65 others who have accepted invitations to membership on the Board, are answering questionnaires on their special skills, abilities and interests.

Primitive mask is viewed by Mrs. Smith, Mrs. Wallace D. Mackenzie and Dr. Donald Collier.

Mrs. Vernon Armour, Mrs. John Shedd Reed, and Mrs. Byron C. Karzas examine Maya rubbing.

Those attending the inaugural meeting were greeted by Mr. Palmer, who emphasized the opportunity for service at the Museum and cited the work of Stanley Field as an example. They toured the Maya Art exhibit and the Robert R. McCormick Laboratory led by Mr. Webber, Dr. Donald Collier, Chief Curator of Anthropology, and Dr. Kenneth Starr, Curator of Asiatic Archaeology.

"No institutions offer as broad a range of public services as do the great museums," declared Mr. Webber during a talk following the luncheon. He stressed that Field Museum's rapid growth, particularly in the educational area, creates challenges for just such a group as the Women's Board.

Museum Director Webber discusses methods of conserving metals with Mrs. James A. Cook, and Women's Board Chairman, Mrs. Smith.

At left Mr. Webber and Mrs. Smith greet arrivals, Mrs. W. Press Hodgkins and Mrs. Derrick Vail.

Mr. Webber, Mrs. Hodgkins and Mrs. Elliott Donnelley after the meeting.

Solomon Gurewitz, Anthropology volunteer, points out polished Tibetan figure to Mrs. J. Harris Ward.

Section of head table, Mrs. Joseph N. Field, Mrs. James L. Palmer, Mr. Webber, Mrs. Smith, Mrs. Cook and Mrs. George W. Beadle.

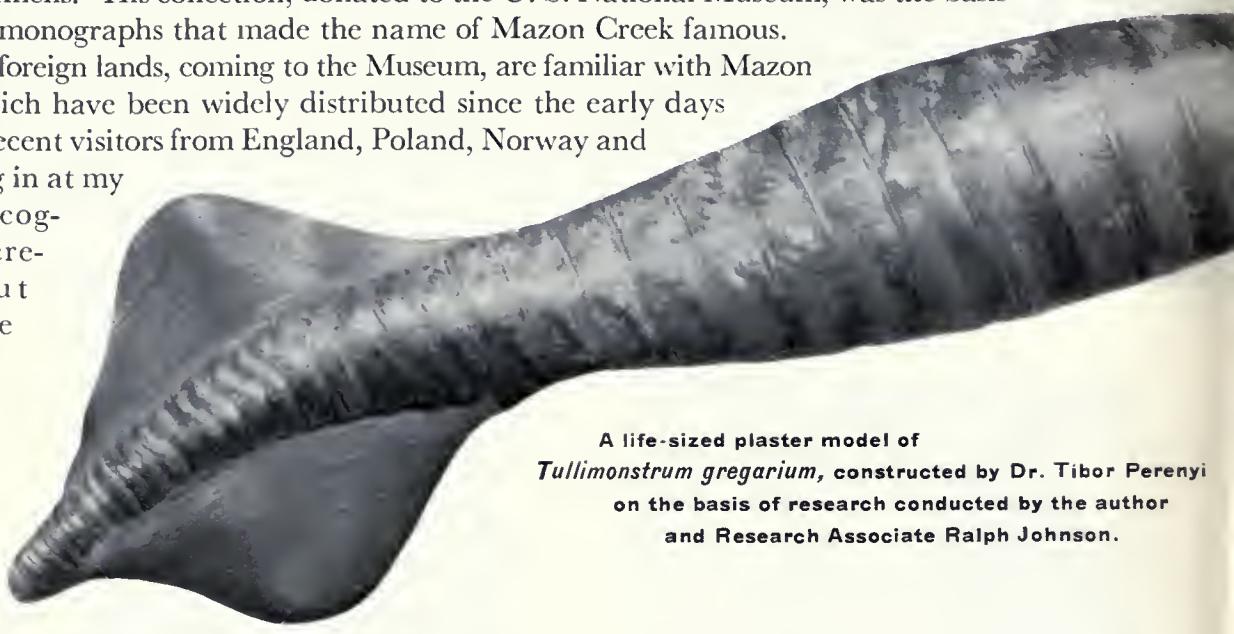
THE TULLY MONSTER

by E. S. Richardson, Jr., Curator, Fossil Invertebrates

Ten years ago, hardly anybody had a Tully Monster. But such is the rapid march of progress, that now there are hundreds of happy owners of this curious fossil. Most of these people have collected their own, from a few square miles of strip-mined land on the Will–Kankakee county line about fifty miles south of Chicago. And Tully Monsters—all from the same locality—have recently been appearing in rock shops around the nation.

For many years the Museum has been interested in the Pennsylvanian, or Coal Age, fossils, 280 million years old, that occur in untold numbers of ironstone concretions in one of the world's great fossil localities almost on our doorstep. A hundred years ago they were eagerly collected from the bed of Mazon Creek, south of Morris, and great collections were made by amateurs living nearby. L. E. Daniels, J. C. Carr, Joseph Even, P. A. Armstrong, F. T. Bliss, John Bronson and many others of these early collectors gave or loaned their unique specimens of fossil invertebrates from Mazon Creek to scientists who described them for the world at large. Ralph Lacoe, a businessman in Pittston, Pennsylvania, actually hired collectors and bought specimens. His collection, donated to the U. S. National Museum, was the basis of several of the monographs that made the name of Mazon Creek famous.

Visitors from foreign lands, coming to the Museum, are familiar with Mazon Creek fossils, which have been widely distributed since the early days of collecting. Recent visitors from England, Poland, Norway and Russia, dropping in at my office, have recognized our concretions without prompting. The quality of preservation and the wide variety of plants and animals represented are equalled in very few other localities.



A life-sized plaster model of *Tullimonstrum gregarium*, constructed by Dr. Tibor Perenyi on the basis of research conducted by the author and Research Associate Ralph Johnson.

Forty years ago, when the fossil-bearing concretions were becoming scarce on Mazon Creek, strip-mining began nearby and the big shovels that dug for coal began dumping loads of the overlying soft shale in great "spoil heaps." In a few years the shale weathered to clay and the concretions appeared on the surface of the hills. Now the field for collecting expanded and another generation of amateurs took up the enterprise. The McLuckie, Herdina, Enrietta, Langford, Thompson and several other great collections were made from the strip mines from the thirties to the present. Gradually, as some collectors fell away, others in growing numbers took their place, and the tradition of cooperating with scientists became their tradition. A list of well over a hundred people now collect these outstanding fossils and allow professional paleontologists to study them. The thousands of man-hours that they invest in collecting are freely placed at the service of science.

As a result of all this activity, rare specimens—the one-in-a-million fossils—are brought to light, and also new localities are discovered and explored. For in these forty years the area of strip-mined land has spread. And thus it was that the Tully Monster swam into our ken.

Back about 1958 a man came to the Museum and asked to see George Langford, at that time the Curator of Fossil Plants. Having introduced himself as Francis J. Tully of Lockport, he showed Mr. Langford some fossils from the strip mines. Soon they had every one of the fossil plants identified, and then Mr. Tully reached into his bag and pulled forth a . .

Monster. *1. something extraordinary or unnatural, a prodigy, a marvel.—The New English Dictionary (Oxford)*

. . . Or so I called it when Mr. Langford showed it to me. Extraordinary it was, indeed, though not unnatural. Clearly outlined on the freshly exposed surface of a split concretion was the impression of a most curious prodigy. At one end of a dirigible-like body was a spade-shaped tail; from the other end extended a long thin proboscis with a gaping claw; across the body near the base of the proboscis was a transverse bar with a little round swelling at each end, outside the body. Mr. Langford confessed that he couldn't say what it was, and so did I when I came back from a field trip a few days later and had a look at it. Mr. Tully kindly left a few specimens with us, and every now and then we looked at them and pondered the matter. We showed them to our colleagues at the Museum and elsewhere; no one recognized the creature. We could not even decide what phylum to put it in, and that was a serious and embarrassing matter.

Every animal belongs in a phylum. Every animal is either an arthropod, a mollusk, a chordate—three of the phyla—or a member of one of some thirty others. It may sometimes be difficult to recognize which phylum is appropriate, especially if one can't see some important character. This is sometimes the case with fossils, since important features may not happen to be preserved. But usually one can recognize *some* similarity to a known animal, and postulate a relationship. The technique is to get a sufficient number of specimens and note all the characters you can find. We put the Tully Monsters aside; perhaps some more specimens would turn up.

Some more did. In the course of strip-mining for coal, the Peabody Coal Company had moved on to a new mine, Pit Eleven, south of Braidwood, and as the spoil heaps weathered, concretions appeared on the surface of the hills. So did collectors. Before long we had several hundred Tully Monsters at the Museum, and knew of other hundreds in basements, garages and front parlors around and about. Pit Eleven was in business. Not only Tully Monsters were turning up there, but other curious fossils as well, not found in Mazon Creek or the other strip mines.

From the older mines we had collected principally fossil leaves, with a smattering of invertebrates and a few fishes and amphibians. The association of plants and animals led us to suppose that they had all lived together in a swampy coastal plain or delta. There were a few marine invertebrates—a chiton, some scallops, a tube-building worm, a cephalopod—but they were very rare. Apparently, we reasoned, the area lay near the shore and had been briefly covered by a fluctuating sea. At Pit Eleven it was different. Chitons and scallops were fairly plentiful, and there were also jellyfish, sea slugs and holothurians (sea cucumbers), all definitely marine. Apparently this area was much more regularly covered by the sea. So Tully

Monsters, being common here, were probably marine animals.

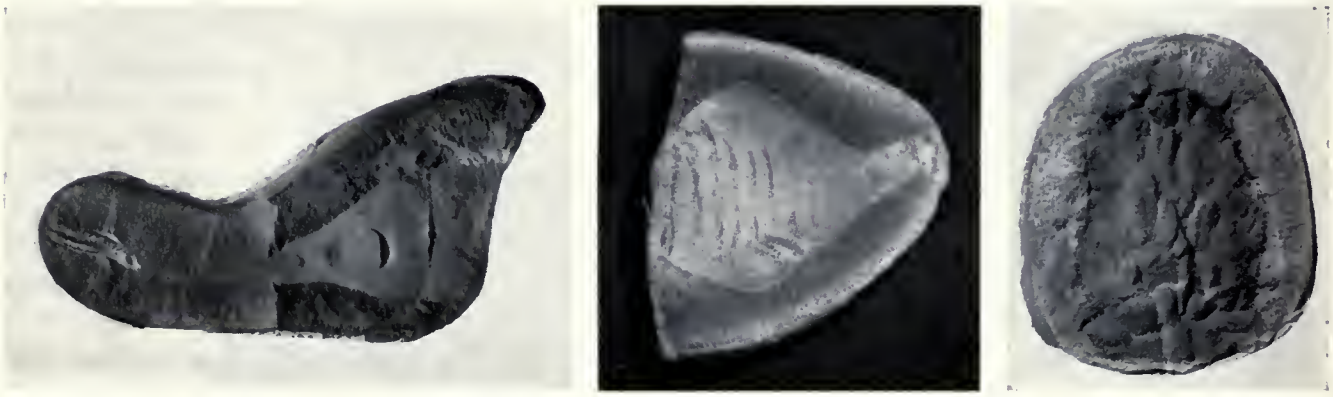
We can now say more about these creatures than when we puzzled over the first ones. But we still cannot place them in a phylum. It is possible that they are the only known representatives of a hitherto unknown extinct phylum—a suggestion that runs counter to our expectation of orderliness in nature. The Monster has been familiar now for some years to numerous collectors, and specimens have gone far afield as one collector swapped with another. Wherever they went, the name went with them, and we had the unusual instance of a fossil with a common name but still not formally introduced to Science. It had to have a proper name.

Accordingly, I wrote a formal description and properly christened our orphan in a note in the weekly journal *Science* of January 7, 1966, but still without being able to mention the phylum. Since the common name was already widely used, I simply latinized it, and called it *Tullimonstrum gregarium*. ("*Gregarium*" means common.)

The picture on this month's cover shows several Tully Monsters as they probably appeared in life, frisking about in a marine environment, with a jellyfish, seaweed, coelacanths, shrimps, a marine worm and a snail. The spade-like tail suggests that they could swim and guide themselves; the segmented body, clearly seen on many fossil specimens, must have been flexible, as is the body of an earthworm. The cross-section, a flattened oval, is conjectural, as all specimens are preserved as mere flat films. We know from many specimens that the proboscis was flexible, and since the claw at its end was armed with eight tiny sharp teeth, it must have been used for grasping prey. Unfortunately, we are still completely in the dark about the mouth and the method of feeding: there is no indication of a "throat" within the proboscis, which was probably just a muscular organ for carrying prey to the mouth. Some specimens have what appears to be a mouth just in front of the transverse bar; some have one just behind, but most have no indication at all of a mouth. The matter remains obscure.

Perhaps the most puzzling feature of the Tully Monster is the transverse bar across its "chest," with the two little round organs at the ends. These round things are lentil-shaped, and contain fine black particles similar to what we find in the eyes of the associated shrimps and fishes. But can they be eyes? Many animals—notably shrimps and snails—have eyes on stalks, but each eye has its own stalk; here the transverse bar is a single stiff unit so that if one "eye" moved forward the other would have had to move backward. Other functions for the round organs have been suggested: a sonar device for navigating in muddy water; suction discs to anchor the Monster to a shark, which could then be pierced by the proboscis; gonads; kidneys; balancing sensors. None of these is quite probable; on balance, I suppose that they are eyes.

The shrimp about to be grasped by one Monster in the cover picture is drawn from a specimen of one of the undescribed crustaceans from Pit Eleven, but it may be doubted that Tully Monsters ate shrimps. Certainly, no shrimp shells are observed in monsters' stomachs, nor does it appear that a Monster had any means of chewing a shrimp. It may not be far-fetched to suggest that it could suck the juices of a shrimp through its proboscis. On the basis that the food in any natural community must be more abundant than the feeders, the different kinds of shrimps that are present remain a possibility, but the leading contender is the Blob.



LEFT: *the Tully Monster's "head" begins at a transverse bar and stretches out to a claw on the end of a stalk. The crescent would certainly be considered a mouth, but it appears on only one-fifth of the Monsters examined.* CENTER: *a tail showing color bands.* RIGHT: *a "Blob," about three inches across.*

Blobs are enormously abundant at Pit Eleven and are large enough to make a proper food supply for *Tullimonstrum*. Nor is there a problem of disposing of shells. Unfortunately, we know even less about Blobs than about Tully Monsters. We can't place them in a kingdom (plant or animal), let alone a phylum, nor do we know which side is up. A Blob might be a type of jellyfish, but Pit Eleven provides specimens of two perfectly good species of jellyfish, and they look quite different. Essentially, a Blob consists of a relatively smooth area, divided into a variable number of lobes, plus a larger area that is rough or much wrinkled, the whole thing making an oval impression as much as six inches long.

Though we have learned a great deal about the curious animal that Mr. Tully pulled out of his bag eight years ago, many significant points are still unknown: particularly its relationship to other creatures and its manner of feeding—both ordinarily among the first bits of information to be learned about a newly discovered form.

JULY EXHIBITION
FLOWER PRINTS BY HENRY EVANS

The fusion of science and art—of botany and interpretative illustration—is the achievement of Henry Evans, San Francisco printer-artist, forty of whose flower prints are on exhibit during the month of July in Hall 9 Gallery. Mr. Evans' linoleum block prints drew praise seldom given by scientists for interpretive art in sciences. Said Dr. Louis O. Williams, *Chief Curator of Botany,* "These have really caught the essential idea of their subjects; everybody will know what plants these are—yet much is stripped away. They're gorgeous."

Praise from art authorities has been equally enthusiastic, with emphasis on the fine interpretative job done by Mr. Evans.

Among plants in the exhibit are American wild and garden flowers such as swamp arrowhead, sweet woodruff and water cress.

Mr. Evans' prints have been exhibited by the Royal Horticultural Society in London, Hunt Botanical Library in Pittsburgh, the California Academy of Sciences and the San Francisco Public Library.

The prints, in limited edition, will be on sale at the Museum Book Shop, priced $5–$10.

Mr. Evans, a native of Superior, Wisconsin, remarks that "when I began work on plants, I suddenly felt as though I had stepped out of the darkness into sunlight." He adds that using wood, he was "unable to achieve the flow of line which plant forms must have to be convincing," but found the line he was after when cutting the softer linoleum blocks.

Artist Henry Evans at work. His prints include such plants as the graceful swamp arrowhead with reflection in water, upper left, *and the ubiquitous grassy sedge,* below.

DELEGATES VISIT MUSEUM

Hundreds of delegates to the record-breaking 61st annual meeting of the American Association of Museums visited Field Museum June 8, as part of a tour of Chicago's principal museums. Many were taken behind the scenes and to outstanding exhibits on special small-group escorted tours. One hundred and fifty of the visitors lunched at the Museum. A general session with greetings by Mayor Richard Daley opened the convention. With 831 persons registered, this year's attendance was the largest in AAM history. An AAM Council meeting and dinner was conducted at Field Museum on the convention's first day. E. Leland Webber, Director of Field Museum, was local arrangements chairman.

MUSEUM HOURS EXTENDED FOR SUMMER MONTHS

Longer summer hours are in effect from now through Labor Day. The Museum will remain open from 9 a.m. until 8 p.m. on Wednesdays, Fridays, Saturdays, and Sundays. These are the evenings on which the Grant Park Concerts are held at 8 p.m., in the band shell just across the street. Dinner will be available in the Museum Cafeteria until 7 p.m.

CALENDAR OF JULY EVENTS

July 1 - 31 Botanical Prints by Henry Evans. Special exhibit of 40 linoleum block prints of American flowers and plants. Hall 9 Gallery.

July and August, weekdays Guided Tours.
2 p.m. tour of Museum highlights, followed by 3 p.m. color film on Museum expeditions, research and exhibit preparation. Tour may be joined at Information Booth.

July 7 Japan. Children's Movie at 10 a.m. and 1 p.m., also a cartoon.

July 14 A Day on the River. Children's Movie at 10 a.m. and 11 a.m., also a cartoon.

July 21 Prehistoric Animals. Children's Movie at 10 a.m. and 1 p.m., also a cartoon.

July 28 A Summer Walk—What can you see? Children's Movie at 10 a.m. and 1 p.m. Movies are shown in James Simpson Theatre. The second showing on July 7, 21 and 28 is scheduled at 1 p.m. to allow children to attend the 11 a.m. Young Peoples' Concerts held in the Grant Park Band Shell across the street.

JULY MEETING Illinois Orchid Society. July 17 at 2 p.m.
Open to members and interested non-members.

EARL EDWARD SHERFF, 1886-1966

Earl Edward Sherff, 79, widely known for his writings on the taxonomy of the genera *Bidens*, *Cosmos* and *Dahlia*, died May 16.

Among his 140 published papers on taxonomic botany, were many published by the Field Museum. He was elected a Research Associate in Systematic Botany in 1936. He was also named a Contributor to the Museum for his gift of nearly 14,000 herbarium specimens and thousands of photographs of type or critical specimens. One of his earlier works, *New Species of Xanthium and Solidago*, was a joint paper with Dr. C. F. Millspaugh, the Museum's first curator of botany, published in *Fieldiana* in 1918.

He served as associate editor of the *Botanical Gazette* and of the journal *Brittonia*, as president and as member of the Council of the American Society of Plant Taxonomists, and of the Council of the American Association for the Advancement of Science, of which he was a Fellow. Both a new botanical library containing his complete botanical writings and a new science building at Illinois Wesleyan University were named in his honor.

Born in Flint, Michigan, Dr. Sherff received his bachelor's degree from Albion College and his graduate degrees from the University of Chicago. He began teaching in Chicago public high schools in 1912, joined the faculty of Chicago Teachers College in 1923 and became head of the Department of Science in 1929, serving until his retirement in 1951.

HENRY HORBACK, 1913-1966

Henry Horback, 53, Assistant in Petrology, died at his desk suddenly on June 13th. He was first employed by the Museum on July 1, 1941, to assist in the cataloging of the collection of fossil invertebrates. His Museum career was interrupted by three years in the Army Signal Corps, 1942–46, after which he returned to his work in the Geology Department. Most of his time in the following years was devoted to the reorganization and reinstallation of the department exhibits. Recently, he had been involved in the preparation of a catalog of the meteorite collection published last year in *Fieldiana: Geology*.

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT RD. AT LAKE SHORE DR.
CHICAGO, ILLINOIS 60605
Founded by Marshall Field, 1893

BOARD OF TRUSTEES
Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
Joseph N. Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Edward Byron Smith
Louis Ware
E. Leland Webber
J. Howard Wood

HONORARY TRUSTEES
Walter J. Cummings
William V. Kahler

OFFICERS
James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM
E. Leland Webber

CHIEF CURATORS
Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Kathleen Wolff, Associate Editors

COVER: *Tully Monsters as they might have appeared in a by-gone sea. drawn for the* Bulletin *by E. S. Richardson, Jr., Curator, Fossil Invertebrates, whose article on this perplexing species appears on page four*

Volume 37, Number 8 August, 1966

BULLETIN FIELD MUSEUM OF NATURAL HISTORY

LIVING WHALES CATALOGED BY FIELD MUSEUM MAMMALOGIST

PEOPLE RAISE BROWS upon meeting a specialist on whales who lives in Chicago, but it is successful repartee to observe that in the jet age, Chicago is about equally convenient to the Atlantic, Pacific and Arctic oceans. It might therefore be a matter more for pride than surprise in cosmopolitan Chicago, that one of its scientists has just produced an important volume on the living whales of the world.

The author of this work, Philip Hershkovitz, has been a mammalogist at Field Museum for many years. Presently Research Curator of Mammals, he is the world's primary authority on the mammals of South America. As a part of his enduring and productive investigations of South American mammals, Curator Hershkovitz undertook to review the whales, dolphins, and porpoises of South American waters. Finding that about two score species were known for South America and that this was almost exactly half the species of living cetaceans in the whole world, he decided to do them all.

The results are published in the 259-page *Catalog of the Living Whales*, just issued by the Smithsonian Institution as *Bulletin 246.** It is a scholarly list of the species of living cetaceans of the world which Philip Hershkovitz finds acceptable as species from evidence published about them. It provides references to the scientific literature of each species pertaining to known geographic distribution and taxonomic relationships. This is the first attempt for 100 years to review the taxonomic literature on the whales, porpoises, and dolphins and to present, by critical evaluation, a scientifically acceptable list of the known species.

It often surprises people to learn that there are as many as eight families of living whales: The family of freshwater dolphins, Susuidae, has only 4 species, but the regular dolphin family, Delphinidae, contains 40 dolphin species, including 2 or 3 that are large enough to be called whales by laymen (the killer whale, for example), and 6 species of porpoises. The beluga and narwhal family Monodontidae, consists of only 2 species, and the sperm whale family, Physeteridae, is also composed of only 2. Hershkovitz's new volume recog-

nizes only 15 living species in the beaked whale family, Hyperoodontidae. Thus, we know of some 69 species of toothed whales. The remaining whales have baleen instead of teeth; there are three families of these baleen whales, totaling among them 10 species.

Joseph Curtis Moore, Curator, Mammals

*Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., one dollar.

The Library of Field Museum houses many rare and curious volumes. Unfortunately, these books, some purchased, many others the gifts of interested members, can only occasionally be exhibited to the Membership and the general public.

For some years, the care of the rare books collection has been among the responsibilities of Associate Librarian W. Peyton Fawcett.

This issue starts an irregular series of articles in which Mr. Fawcett will present various parts of the collection to the readers of the BULLETIN. *He views them not only as important historical and scientific works, but as beautiful examples of the printer's art. He begins here with the works of the German-Swiss naturalist, Conrad Gesner.*

Conrad Gesner

BY W. PEYTON FAWCETT, ASSOCIATE LIBRARIAN

PERHAPS THE MOST ADMIRED of the early naturalists—for his life as well as his works—is the great German-Swiss scholar and physician Conrad Gesner (Gessner), styled by Linnaeus "the ornament of his age."

He was born into a large and very poor family on March 26th, 1516 at Zurich, Switzerland. Because of their poverty his parents could do little to encourage his early interest in reading and learning. The rudiments of his education and his taste for natural history, especially botany, he owed to his mother's uncle, Hans Frick, a Protestant minister. In 1531 his father fell in the battle of Kappel, the same in which the famous reformer Zwingli died, and Gesner was left to make his own way in the world. He received from the city of Zurich a traveling scholarship and went to the University of Strassbourg to study medicine, and subsequently to the universities of Bourges and Paris. He remained for some time in Paris studying the Greek and Latin languages and literature. When his means failed he returned to Zurich (1535), married, and supported himself by teaching. In 1537 Gesner was appointed Professor of Greek at the University of Lausanne. Three years later his native town gave him another small scholarship to complete his medical studies. He studied for a short time at the University of Montpellier; but went on to the University of Basle where he completed his studies and received his medical degree in 1541. Shortly thereafter he began practicing in Zurich.

After this Gesner's life became more settled. He was able to support himself by his medical practice and literary efforts. Indeed, such was his success that he was appointed Chief Physician and Public Professor of Philosophy and Natural History by the magistrates of Zurich in 1554. He built up a large botanical garden and established in his house what is probably the first natural history museum. The latter is described by his biographer Schmiedel in this way:

"[It] contained fifteen windows. These windows he ornamented in a manner as unusual as it was agreeable; on each of them he painted most elegantly on the glass, arranged according to their classes, different species of marine, river, and lacustrine fishes. His shelves contained an immense quantity of metals, stones, gems and other natural productions, which he has either obtained as presents from his friends, or purchased. . . . Amidst these riches of nature, he was often wont to spend his time, seeking tranquillity of mind from the contemplation of them, and refreshing himself after the numerous toils and vexations of life, from which the best are not exempted."

He was able to make many tours among the Alps and in Germany, France and Italy, studying natural history and visiting libraries and scholars. From these he returned with many new specimens for his botanical garden and museum.

In 1564 Zurich was ravaged by the plague, and Gesner, as public physician, combatted it to the best of his ability and at the risk of his own life. The disease abated that year but returned to the city with renewed virulence in the middle of July, 1565. Gesner again went about helping the victims and was himself stricken on Dec. 9th. What is described as a large "pestilential carbuncle" appeared under his right arm and another on his breast; but there was no pain in the head

or fever. Gesner had seen many die with precisely these symptoms and therefore did not expect to recover. He called his friends together, made his will, and serenely awaited death. On the fifth day of his illness he felt that the end was near and had a bed set up in his museum. There, on December 13th, 1565, "he expired," in the words of one of his biographers, "amid the monuments of his labours, thankful for what he had been able to accomplish, and supported by all the pious hopes and consolations of a Christian philosopher." He was only 49 years old.

Everyone who has written of Gesner has expressed surprise at the amount of work he was able to accomplish despite the difficulties of his early years, the many duties of his chosen profession, his frequent illnesses, and his early death. One writer, speaking of his "History of Animals" remarks that, instead of being the work of a busy man of the world, ". . . one would suppose it the labour of a recluse, shut up for an age in his study, and never diverted from his object by any other cares." Moreover, the range of his works is tremendous, including studies in language, literature, medicine, natural history, and theology.

In 1545 he published the first part of his famous *Bibliotheca Universalis*, a critical catalog of all known Greek, Roman and Hebrew literature, giving, in addition to the authors and titles, some information on the contents of the works mentioned, a specimen of the style, and an estimate of the value of the work. The second part, titled *Pandectarum*, was issued in 1548 and is divided into 19 books, arranged by subject. The 20th book, on medical subjects, was never completed; the 21st, on theological subjects, was issued in 1549. In 1555 he published his *Mithridates*, an account of about 130 languages then known, with the Lord's prayer in 23 of them. He also issued many editions of Greek and Latin authors, with notes and commentaries, dictionaries, more than one edition of Galen, and several small works on medicine, including one on milk and another on the plague.

Of his works on natural history the *Historia Animalium* is the work usually associated with his name and the one on which his reputation is principally based. The "History of Animals" appeared in five folio volumes, published in Zurich between 1551 and 1587. Vol. 1 (1551) treats of viviparous quadrupeds; vol. 2 (1554), oviparous quadrupeds; vol. 3 (1555), birds; vol. 4 (1558), fishes and other aquatic animals; and vol. 5 (posthumous, 1587), snakes. The whole work extends to 4,500 pages and contains several hundred woodcuts, the great majority of the animals discussed being represented.

Two pages from Volume 1 of Gesner's HISTORIA ANIMALIUM. *On the right is* Dama vulgaris, *the common fallow-deer, or as Gesner spells it, "falouue deere." At one time these deer were royal property and were kept and hunted in extensive park areas. Linnaeus, in preparing his* SYSTEMA NATURAE, *made great use of Gesner's zoological work. Thus, the text and illustration shown below are cited by him in establishing the scientific name of the species,* Cervus dama. *Today, this species is known as* Dama dama *of the deer family,* Cervidae.

Our library has only vol. 3 of the first edition. Vols. 1 and 2 of our set are of the second edition (Frankfurt, Germany, v. 1, 1620, v. 2, 1617). Vols. 4 and 5 are German translations from the original Latin: *Fischbuch* (Zurich, 1575) and *Schlangenbuch* (Zurich, 1589).

The general arrangement of the work is Aristotelian, the main division being between land and water animals. Whales, for instance, are included among the fishes, and bats among the birds. Animals are assigned to different orders on the basis of domestication, size, and similar criteria, and are discussed, for the most part, in alphabetical order. Each is described under eight headings: 1—the names in different languages, ancient and modern; 2—external characteristics and native country; 3—mode of life; 4—habits and behavior; 5—capture, domestication, and rearing; 6—uses as food; 7—uses as medicine; 8—references made to them by authors, moral uses, historical allusions, etc.

The many woodcuts that grace these volumes are, in our time, probably their best known feature, particularly those of monsters (the sea serpent) and mythical animals (the bishop-fish, the monk-fish, and the unicorn). It is surprising that Gesner could incur the expense of having so many engraved; for, as one writer has pointed out, "He must have had what may be almost called a little manufactory under his charge; and we are told that the artists resided in his own house."

In Gesner's time and for many years thereafter this work was considered the principal authority on zoological subjects and was reprinted, abridged, and translated many times. Despite its limitations, it is still useful to a certain extent today, particularly in determining the names of animals in many different languages, and as primary source for many generic and specific names.

Gesner was well known to his contemporaries as a botanist but his projected "History of Plants" was never written. Ellison Hawks in his *Pioneers of Plant Study* (New York, 1928) gives us some idea of what the text of this work would have been, using as his sources some of Gesner's letters:

"He recognized species as falling into groups and genera, and as varying in minor and less constant characters. It is possible, therefore, that he had a clearer conception of classification into groups of progressively increasing generality than any of his predecessors. He also insisted that flower, fruit, and seed afford better indications of affinity than do mere habit or foliage. This sound opinion he supported by adding details of flowers and fruits to his drawings in a manner that had not been done before." (*Continued on page 7*)

Two pages from Gesner's Fischbuch *(German translation of Volume 4 of* Historia Animalium*). The illustrations are after the "History of Northern Peoples" of Olaus Magnus (Olaf Storr), 1490–1538, Catholic Archbishop of Upsala, Sweden. Besides ethnographic matters, the book deals with game animals, birds, fishes, and various "midnight wonders" including the whales pictured below, and sea serpents. Gesner apparently had his doubts about the validity of the latter, for he notes that the responsibility for the truth and accuracy of these illustrations rests with Olaus.*

Der zwölffte teil von
Von dem Barrwall.
Von dem gehareeten Wall.
Allerley Wallfischen. XC
Von dem grab wall.
Von dem schopffwall vnd hornwall.
Von dem sprütz oder blaßwall.

The Question of Importance in Zoology

by Austin L. Rand, Chief Curator, Zoology

IN SEARCHING OLD BOOKS for a clue to what is important in zoology, I came upon an intriguing statement by Buffon, who wrote the many volume "Histoire Naturelle . . . ," nearly 200 years ago. Comte George Louis Leclerc Buffon was zoologist-laureate of the court of Louis XV. A brilliant man, a polished courtier, and the innovator of a theory of evolution a century before Darwin, he was criticized by church and scientist alike. But his influence helped natural history gain respectability, social prestige, and patronage. Once when criticized for devoting more space in his books to some animals than to others, he quipped, "An animal should not occupy more space in man's mind than it occupies in nature."

This is a wonderful statement to take for a text, or as the basis of a debate. Perhaps there is something here that can provide an objective criterion in a field dominated by subjectivity. But first we should look at the statement and see what it can mean.

If it means equating size of animal with its importance, as seems the case, the solution is easy. Let us illustrate it with this well known example:

Animal	*Weight*
Moose	1,000 lbs.
Deer	200 lbs.
Meadow mouse	.2 lbs.

At first glance the moose appears 5,000 times more important than the mouse.

But another interpretation of Buffon's statement is possible. By "an animal" one could assume a species rather than an individual. The sum total of a small, common animal could outweigh that of a large, rare species. Let us look at our three examples again, on the basis of the combined weight of the individuals of a species (the biomas) per acre.

	Individual Weight	*Individuals per acre*	*Biomas per acre*
Meadow mouse	.2 lb.	100	20 lbs.
Deer	200 lbs.	.05 *1 per 20 acres*	10 lbs.
Moose	1,000 lbs.	.005 *1 per sq. mile*	1.5 lbs.

In the total amount of animal per acre, i.e., space occupied, the mouse is nearly 14 times as important as the moose. This is not an illusion. The mouse uses solar energy many times greater than that used by the moose.

But there are many other factors besides size or bulk in estimating importance in the complex world of nature. Just as "no man is an island," so, no animal lives alone. It is part of a web of life, each eats something and is eaten by something else. Each is part of the food chain of the web of life.

Again, let us illustrate with an example: To the Yankee whalers who used to ship out of New Bedford, a blue whale 100 feet long, weighing over 100 tons was a pretty important animal. But the small shrimp-like animals, smaller than the shrimp served in a shrimp cocktail, that swarm in the nutrient-rich waters of polar seas were no concern of the whalers and were grouped under the general name of brit or krill. Yet these shrimp are the main food of the blue whales, the "grass" of the ocean that the whale strained from the sea water with its elaborate sieve of whalebone. Without the brit, there would be few whalebone whales.

There are interrelationships even more obscure and com-

plex than the simple food chain mentioned. There is the whole question of how animals get their energy from the sun, the sole source; and how they get materials from the air and the soil through the intermediate role of plants. The relationship of plants and animals in maintaining the carbon dioxide and oxygen content in the air, and the very important role of certain soil bacteria which are involved in making nitrogen available to living things, are all to be considered in judging relative importance.

So many and such diverse ramifications of zoology may be confusing. Can we pick out what is important to study in animals? What aspect of our research is of most value? This question of importance in non-commercial fields of human endeavor, of values that cannot be counted by a banker, is an old one. To follow an old custom, we can suggest a partial answer by using an allegory. A stone building was being constructed. A certain stone was rejected. It did not fit into foundation or wall, so it was put aside. But as the building was nearing completion, a keystone was needed. Then it was found that only the rejected stone fitted, unifying the whole structure, making it complete and solid. The moral, of course, is pointed up by asking what is the important brick in a wall, the important link in a chain, the important thread in a net? Similarly, what can be the important units in as complex a system as that of the biosphere?

Biology is studied at many levels of organization: that of the molecule, cell, tissue, organ, whole animal, ecological community and fauna. There is structure, behavior, and function at each level. There are also specialties such as reading the genetic code, the role of hormones as messengers, and intelligence and learning. Among the newer approaches is the possibility of argon-potassium dating that may enable us to study evolutionary rates of phyletic lines well documented with fossils. A scientist must specialize to excel in the study of one small part of biology as applied to only a few of the one million species of living animals. Museum zoologists usually specialize in some branch of knowing and understanding the kinds of animals there are, the diversity of kinds of living things.

But when we look for importance, how are we judging? A materialist may point to how science has been made to pay. A humanitarian may point to how man's lot has been bettered by science, providing more food or controlling disease. A transcendentalist throws up his hands. One scientist may point out how his fashionable subject has gained material support. A philosopher may point out that increase in knowledge of animals, of which he is one, has enabled man to understand himself and the world of nature in which he lives and of which he is a part.

What is important in zoology may be a meaningless question. But we can suggest that the most dramatic story in biology, the epic of life, its saga, is the adaptation of living things to their changing environment and to each other. This is evolution that started with simple life forms in the sea a billion years ago. From it has been produced the great diversity of intricately fashioned and complexly interrelated organisms we know. It has affected every organism at every level, in every function, and it is a process that is still going on.

GESNER (*Continued from page 5*)

At the time of his death he had accumulated about 1,500 of these drawings and 400 wood-blocks. These passed from hand to hand for almost 200 years, the remnants being published in two volumes at Nuremberg, Germany, 1751–1771. Unfortunately, we do not have a copy of this valuable work.

Of his many smaller works, the library possesses a copy of his book on fossils, *De Rerum Fossilium, Lapidum, et Gemmarum* (Zurich, 1565). In this work he discusses all things that are dug out of the earth and provides illustrations of various fossils, stone implements, and even a lead pencil!

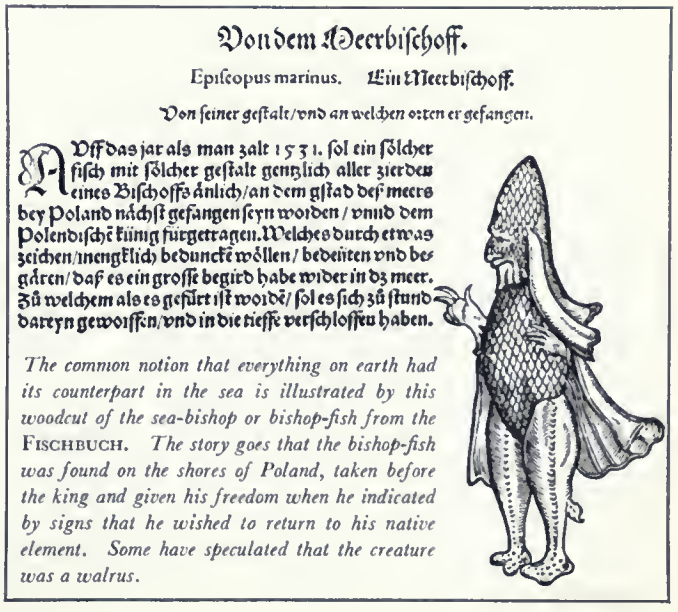
Fischbuch

Das ist ein kurtze / doch vollkomme be-

Title-page from the FISCHBUCH.

The best summation of the value of Gesner's work appears, I believe, in the "Memoir of Gesner" prefixed to the volume of *The Naturalist's Library* dealing with horses (Mammalia, v. 12; Edinburgh, 1841):

"With much that is crude, obsolete, and useless, the necessary consequence of the period and circumstances under which he wrote, his publications must be regarded as of great merit, displaying a wonderful accumulation of knowledge derived from previous writers, with an important accession resulting from his own observation and power of thought. Whether we consider them as a repertory of the existing knowledge of the times, or in reference to the light which they for the first time shed on the subjects of which they treat, they must ever secure for their author a venerable name among the "Fathers of Natural History."


Von dem Meerbischoff.

Episcopus marinus. Ein Meerbischoff.

Von seiner gestalt/vnd an welchen orten er gefangen.

Anno das jar als man zalt 1531. sol ein sölcher fisch mit sölcher gestalt gentzlich aller zierden eines Bischoffs ánlich/an dem gstad des meers bey Poland nächst gefangen seyn worden / vnnd dem Polendischē küng fürgetragen. Welches durch etwas zeichen/mengklich bedunckē wöllen / bedeüten vnd begären/ daß es ein grosse begird habe wider in dz meer. Zů welchem als es gefürt ist worde/ sol es sich zů stund dareyn gewoffen/vnd in die tieffe verschlossen haben.

The common notion that everything on earth had its counterpart in the sea is illustrated by this woodcut of the sea-bishop or bishop-fish from the FISCHBUCH. *The story goes that the bishop-fish was found on the shores of Poland, taken before the king and given his freedom when he indicated by signs that he wished to return to his native element. Some have speculated that the creature was a walrus.*

MUSEUM REPRESENTED AT PACIFIC SCIENCE PARLEY

Four Field Museum scientists with research interests in the Pacific area will participate in a three-week science conference in Tokyo beginning August 22. Dr. Robert F. Inger, Curator of Amphibians and Reptiles, Dr. Joseph C. Moore, Curator of Mammals, Dr. Alan Solem, Curator of Lower Invertebrates, and Dr. Kenneth Starr, Curator of Asiatic Archaeology and Ethnology, will be among the hundreds of scientists attending the Eleventh Pacific Science Congress.

The Congress, a regularly conducted gathering, focuses on a wide range of scientific studies relating to the Pacific region. Its aims are promotion of the investigation of regional scientific problems, particularly as they affect the welfare of the area's peoples, and to strengthen the friendly bonds between scientists of various countries.

Field Museum representatives will present six papers. Dr. Inger's subjects are "Reproductive Patterns of Lizards in a Bornean Rain Forest" and "Competitive Relations Among Three Species of Rain Forest Frogs." Dr. Moore will report on "Evidences of Maturity and Sexual Dimorphism in Beaked Whale Species of the Genus *Mesoplodon* from the Pacific Ocean" and "First Quantitative Evidence Upon the Relationship Between the Four-Toothed Whales, *Berardius bairdi* of the North Pacific and *B. arnuxi* of South Temperate Oceans." Dr. Solem's subjects will be "Age and Origin of Pacific Land Snail Fauna" and "Morphological Changes Associated with Vitriniform and Succineiform Shells and Their Bearing on Gastropod Classifications."

Following the conference, Dr. Starr will visit Chinese collections in Tokyo and Kyoto in connection with his study of the Chinese black pottery culture and Chinese rubbings.

ALMA MATER HONORS CURATOR BLAKE

In recognition of his scientific work on neotropical birds, Emmet R. Blake, Curator of Birds, received the honorary degree of Doctor of Science on May 29 from his alma mater, Presbyterian College of South Carolina, Clinton, S. C. Blake has been on the Museum staff since 1935, and has contributed substantially to the knowledge of the rich bird fauna of Central and South America. He is presently working, under a National Science Foundation grant, on a "Manual of Neotropical Birds," in several volumes.

MUSEUM ATTENDANCE SOARS

The Museum has enjoyed increased attendance of over 30% during the first half of 1966. With 950,000 visitors through June of this year, total 1966 attendance is expected to far outstrip last year's million and a half. This year's peak attendance so far came in April, with 249,000 visitors, the second highest of any month since 1934. April attendance represented a 60% increase over the same month in 1965.

The greater number of Museum visitors may be attributed to increasing public interest in natural history and archaeology, as well as to more Museum visits by school groups. New exhibits like the Chalmers Topaz, special shows like the Maya Art show, and modernized display of existing exhibits such as the Benin Art and that of Bushman, the famous gorilla from Lincoln Park Zoo, have all contributed to drawing more visitors to the Museum.

CALENDAR OF AUGUST EVENTS

August, weekdays Guided Tours

2 p.m. tour of Museum highlights, followed by 3 p.m. color film on Museum expeditions, research and exhibit preparation. Join tour at Information Booth. Children's Movie at 10 a.m. and 1 p.m., also a cartoon.

August 4 The Arctic Region and Polar Bears

Children's Movie aat 10 a.m. and 1 p.m., also a cartoon.

August 11 Water Birds

Children's Movie at 10 a.m. and 11 a.m., also a cartoon. Movies are shown in James Simpson Theatre. The second showing on August 4 is scheduled at 1 p.m. to allow children to attend the 11 a.m. Young People's Concert held in the Grant Park Band Shell across the street.

MUSEUM AUDITOR RETIRES

Miss Marion K. Hoffmann, Auditor of the Museum, retired on June 30 after 14 years service. Miss Hoffmann was appointed the first woman Auditor in 1957, in recognition of her capable record in the auditing office.

She brought to the finance office a very real concern for the financial matters, both personal and professional, she was called upon to solve on behalf of the Staff and visiting scientists. Probably only one who has been associated with a museum with widespread activities in many parts of the world can appreciate the multiplicity of problems that arise, most of which are almost unique.

The period of Miss Hoffmann's incumbency was one of growth of the Museum's financial operations, both in size and complexity. It is a tribute to her dedication to the Museum that the records were in the fine condition they were at her retirement, in spite of the constantly increasing demands of the office. The Museum is indebted to her for her loyal service and also for remaining in office for 3 years beyond normal retirement, a period which allowed much reorganization of the financial records by personnel under her supervision.

Miss Eleanor Sheffner, Assistant Auditor, also left the service of the Museum recently. Miss Sheffner resigned after ten years' service to accept another position. Much of the progress made in recent years in the financial records is directly attributable to the meticulous care with which she handled every aspect of her work.

Both of these ladies will be missed by their many friends at Field Museum who extend best wishes to Miss Hoffmann in her retirement and to Miss Sheffner in her new association.

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT ROAD AT LAKE SHORE DRIVE
CHICAGO, ILLINDIS 60605 A.C. 312, 922-9410

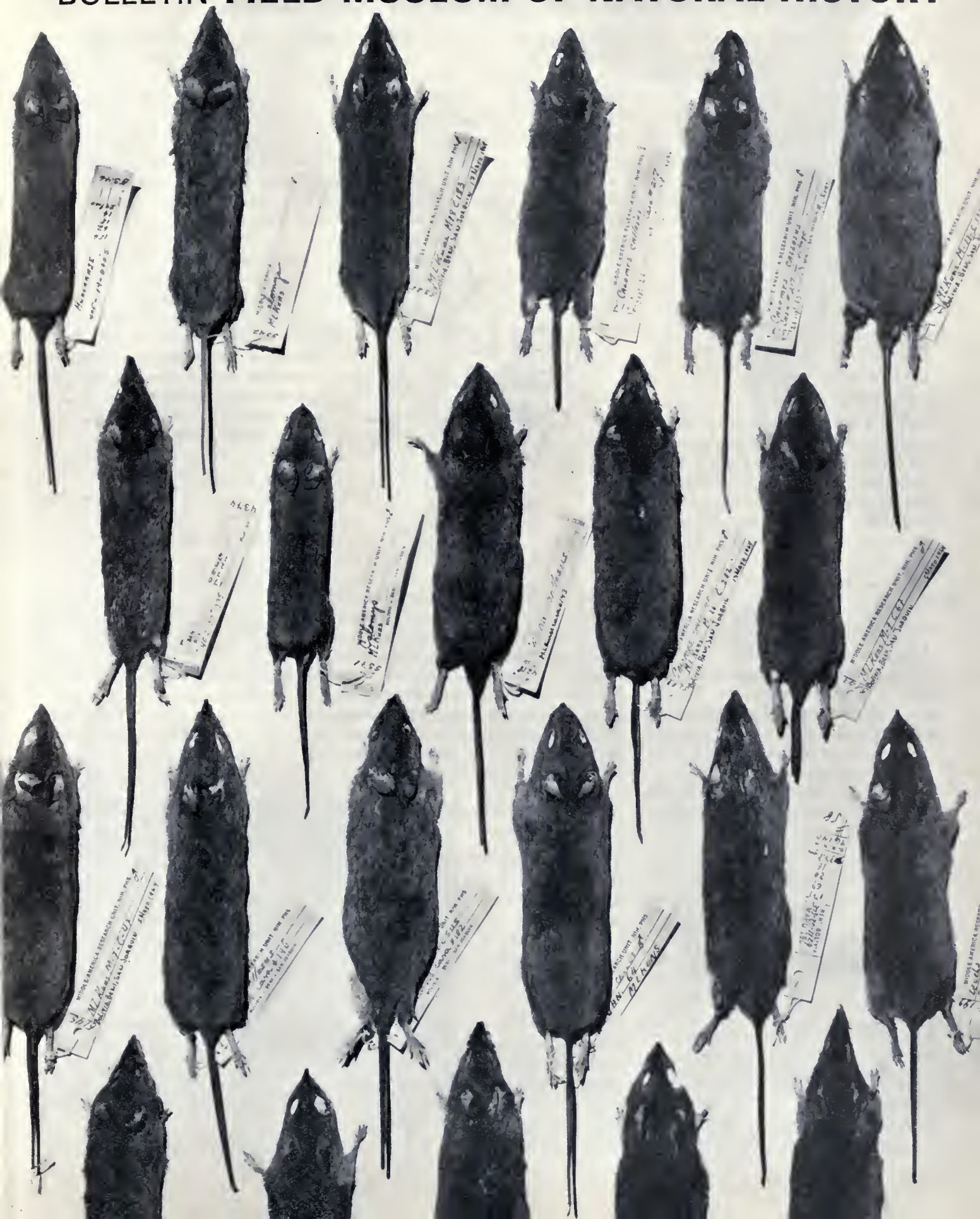
E. Leland Webber,
Director of the Museum

Edward G. Nash, Managing Editor
Beatrice Paul, Associate Editor

FOUNDED BY MARSHALL FIELD, 1893

Volume 37, Number 9 September, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**



FALL WORKSHOPS FOR MEMBERS' CHILDREN

An opportunity to meet Museum staff, and work with specimens and materials from the Museum's scientific collections, is again offered in a series of unique workshops open to the children and grandchildren of Members. Designed by the Raymond Foundation to stimulate and develop interest in the study of nature and man, these small-group workshops, geared to different age levels, have been enthusiastically received by Museum Members and their families since the fall of 1963. This year five new programs have been added.

Reservations are necessary and application forms are enclosed with this month's BULLETIN. Since it will probably not be possible to accommodate all applicants, we urge you to mail in your applications early. Please list the program, date and hour you wish, in the order of preference. Each applicant will be scheduled into *one program only*, and reservations will be accepted in the order in which they are received. Applicants accepted will receive a confirmation card which will serve as an admission card to the workshop.

OCTOBER 1

10:30 A.M. for ages 6 and 7
Parents are also invited

1:30 P.M. for ages 8 and 9
Parents are also invited

Life in an Old Dead Tree

Marie Svoboda

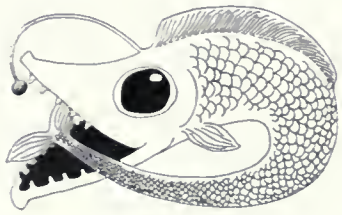
This is a special program for family groups and will demonstrate the different kinds of animals that might make their home in an old dead tree. Such a dwelling place is picked, not for its beautiful setting nor for its beautiful view, but for the protection it affords.

10:30 A.M. for ages 10–12

Ocean Life

George Fricke

A glimpse of ocean life will be presented through films and the handling of specimens of marine invertebrates. The sea is a source of wonder about which man still knows very little. Boys and girls will learn a little of what is already known and how much has yet to be discovered. A short tour in the exhibition halls will acquaint the youngsters with some of the marine vertebrates.



OCTOBER 8

10:30 and 1:30 P.M. for ages 10–12

Indians of Woodlands and Plains

Harriet Smith

In different regions, Indian tribes developed a life that fitted their kind of country by exploiting materials furnished by nature. In this workshop, youngsters will handle these raw materials and see for themselves how their qualities were utilized in the making of tools, weapons, and household equipment. Movies that show how Indian tribes lived in the woodlands and western plains before the settlers came give a basis for class discussions comparing Indian ways of life.

10:30 A.M. for ages 6 and 7 accompanied by at least one parent

Boneyard Menagerie

Ernest Roscoe

This workshop will "rattle the skeletons in a few closets" by discussing the prehistoric relatives of familiar animals found in zoos and aquaria. Be prepared for a few surprises!

OCTOBER 15

10:30 A.M. for ages 6 and 7 accompanied by at least one parent

Boneyard Menagerie (See above)

10:30 A.M. and 1:30 P.M. for ages 10–12

Ocean Life (See above)

OCTOBER 22

10:30 A.M. for ages 10–13

Caveman to Civilization

Edith Fleming

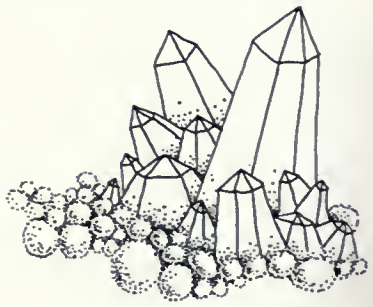
A movie on the life of the cave men, which shows how they hunted prehistoric animals, opens this workshop. In the following discussion-demonstration period, boys and girls will examine real tools used by cave men thousands of years ago, learn how they were made, and compare them with tools of today.

10:30 A.M. for ages 8 and 9

Rockology

Ernest Roscoe

A beginner's introduction to rocks and minerals by means of specimen study, demonstrations, and informative session in the exhibition halls. Topics include:



what are rocks? how are they formed? what characteristics can the beginner use in identifying rocks?

1:30 P.M. for ages 10–13

Rock and Mineral Kingdom

Ernest Roscoe

This is a more advanced program on rocks and minerals. Reading and writing skills are required for the work with specimens and question sheets in the exhibition halls. (*continued on Page 12*)

The Legacy of
MALVINA HOFFMAN

On FEBRUARY 21, 1930, a handwritten note came to the Registrar of Field Museum, from the President of the Museum: "Please open a new a/c [account] on the books 'Hall of Physical Anthropology' & put Mr. Marshall Field's check to the credit of that a/c [signed] S. Field." That same month, a telegram to Miss Malvina Hoffman, the New York sculptor, "Have proposition to make, do you care to consider it? Racial types to be modelled while traveling around the world," brought Miss Hoffman to Chicago and a meeting with Stanley Field and the Board of Trustees of Field Museum.

The relationship established at this meeting lasted for many years, and produced "The Races of Man," Field Museum's most famous exhibit, and Miss Hoffman's most monumental work, 104 bronzes, life-size or larger, revealing, as Miss Hoffman wrote, "man to his brother."

The original plan of the project was worked out at the Museum. Miss Hoffman wrote of the Board of the Museum, "a very alert and courageous group of men. To keep abreast of the times, they decided, after investigating the reasons why the anthropology halls in all countries were generally empty and the snake and monkey houses always crowded, to step out of the tradition and take a long chance. They felt that 'The Races of Man' should *look alive*, and be actual figures that anyone could recognize and feel to be authentic . . . so they decided to try sculpture. . . ."

Though the conception of the plan belonged to the Museum, the work was Miss Hoffman's, and the final product bore the stamp not only of her artistic skill, but of her strong beliefs. The Museum had planned to hire four or five artists to go to various parts of the world. Miss Hoffman pointed out that such an arrangement could not produce a consistent, balanced hall. She also pointed out the potential battles involved in four or five artistic temperaments. She won her point. She was commissioned alone to do the job.

Again, the original plan called for plaster figures. Miss Hoffman felt strongly about this point: "I signed up for

Miss Hoffman in her studio

"Daboa", Dancing girl of the Sara tribe, Lake Chad

painted plaster, real hair and glass eyes, knowing absolutely that within six months this part of the contract would be changed without a struggle." She had two of the figures cast in bronze at her own expense in Paris and when Stanley Field saw them at her studio, that part of the contract was changed.

She spent the next several years traveling the world for the Museum, sketching and sculpting, and slowly assembling the exhibit. Miss Hoffman had considerable skill in persuading normally shy people to pose for her. She was undaunted by primitive conditions, and overcame inevitable difficulties with great courage.

Only 80 per cent completed, the Hall of Man opened on June 6, 1933, at the time of the opening of the International World's Fair in Chicago called the *Century of Progress*. More than 2,000,000 people visited the Hall in its first year, and countless millions since that time.

When Malvina Hoffman died this summer in her home in New York, at 81, a full and varied life, rich with achievement, was ended. She left books, sketches and statues. Mankind was her subject, and she left Mankind perhaps no greater legacy than the sense of the diversity and unity of all people to be found in Field Museum's Hall of Man.

museum taxonomy SERVES medical research

BY PHILIP HERSHKOVITZ, RESEARCH CURATOR, MAMMALS

THE VISITOR, an epidemiologist from the National Institutes of Health, had a problem. He had been assigned to a team of United States medical officers investigating a high mortality febrile disease attacking man in the Amazonian region of Bolivia. The disease, a hemorrhagic fever, had been occurring in epidemic fashion for three years—since 1959.

The virus causing it was found in a sample of human spleen from a fatal case of the fever. A wild rodent reservoir of the virus was suspected. My visitor, Dr. Merle Kuns, wanted information on the mammals, particularly the rodents, of Bolivia. Little is known of Bolivian rodents but happily much of it is contained in scientific publications of the Field Museum. Dr. Kuns was provided with the literature he needed, and I agreed to identify the samples of suspect animals he would collect in Bolivia and send on to the Museum.

The specimens soon began to come in. The first shipments of hundreds of mice, bats and other kinds of small mammals had already been tested and had proved negative for the virus of hemorrhagic fever. Serological tests conducted in virus laboratories on the associated mites, ticks, lice and fleas were also negative. The break came in 1963, when the virus was isolated from two field mice trapped in the village of San Joaquín, Beni. These mice, which I identified as *Calomys callosus*, resemble common house mice (*Mus musculus*). Like them, they live successfully in fields, gardens, houses and towns. Further investigations by the epidemiologists revealed that *Calomys callosus* was a natural reservoir of the disease. It communicated the illness to humans by direct contamination of their food, water, clothing and furnishings with virus excreted in feces or urine. Destruction of *Calomys*

callosus living in houses in San Joaquín resulted in a dramatic end to human cases of hemorrhagic fever.

One of the scientific publications of the Field Museum used by the Bolivian Commission in their investigations of hemorrhagic fever was a taxonomic revision of the mice of the genus *Calomys*. The treatise contains everything known to that time about these rodents, including habits, preferences for human habitations, ectoparasites, geographic distribution, distinctive characters and keys to the species. Taxonomic works of this kind are regularly produced by the Museum's zoologists. Most of them may seem abstruse and of no practical value today. Tomorrow they may be crucial in tracking down the cause of an epidemic devastating a far-away jungle land or identifying the agent bringing a new disease into our country.

ZOONOSES.—Diseases of wild animals transmitted to man or his domestic animals are called *zoonoses*. The World Health Organization lists over 100 zoonoses and more are being added each year. A classic zoonosis is bubonic plague transmitted to man by fleas from the natural reservoir in rodents. Rabies, transmitted by the bite of infected dogs, wolves, bats and other animals, is another example of a zoonosis which, like Bolivian hemorrhagic fever, does not involve an arthropod vector.

TRAVELING TICKS.—Ticks are known vectors of a great variety of organisms causing diseases in man and domestic animals. These arthropods may not travel far on their own power, but they can be intercontinental travelers when attached to migrating birds. Dr. Harry Hoogstraal, a Research Associate of Field Museum and Scientist with the United States Naval Medical Research Unit Number Three, Cairo, Egypt, examined ticks on tens of thousands of migratory birds captured in Egypt. Associate Curator of Birds Melvin Traylor collaborated by providing the identifications and migratory patterns of the birds. These investigations revealed that

Distribution of the Corncrake, Crex crex. *These birds are common in Egypt in autumn when on passage from their breeding grounds in Europe to their wintering grounds in Africa, and many are found to be carrying ticks of medical importance.*

European and northern Asiatic birds migrating south to tropical Africa were infested with ticks from their northern habitats, while birds returning north in the spring carried ticks from their southern winter quarters. Nearly all air-borne ticks were immature. The species of ticks proved to be known reservoirs or vectors of many diseases afflicting humans and domestic animals. One kind transmits Russian spring–summer encephalitis, infectious nephroso-nephritis and tularemia. Another harbors the pathogen causing boutonneuse fever or African tick typhus, a disease related to our Rocky Mountain spotted fever. Still others are carriers of Q fever and of brucellosis. Diseases of domestic animals spread by tick species found on migrating birds include Rickettsia fever, bovine babiosis, anaplasmosis, tick paralysis, Gonderia, and many others. Transportation of ticks far beyond the geographic limits of their normal habitat may explain the sudden and explosive appearance of tick-transmitted diseases in previously uninfested regions along the routes of migrating birds. The most difficult problems in the investigations of such diseases, according to Hoogstraal and his associates, are the taxonomic. Correct identifications are crucial:—of ticks, particularly in the immature stages, bird hosts, and viruses.

COOPERATION AND MUSEUM EXPEDITIONS.—Field work on wild animal reservoirs and vectors of human diseases is conducted by many governments, and they maintain excellent cooperation and exchange of communication with scientific agencies with taxonomic capabilities. Early last year I received a letter from an epidemiologist in British Honduras employed by the Ministry of Overseas Development of the British Government. He was investigating mammalian hosts and insect vectors of Leishmaniasis, and wanted some small rodent hosts identified. I gladly did this for him. More recently, several species of mice suspected or implicated in the transmission of sylvatic diseases in Colombia were sent to me for identification by Rockefeller Foundation virologists conducting the field investigations. There is nothing unusual about this. Samples of small mammals are sent here for identification from many parts of the world.

The Museum's identification service is a voluntary contribution. The Museum's biologists are primarily interested in their own broadly based research programs, some of which include field studies of host-parasite relationships. The W. S. and J. K. Street Expedition to Afghanistan of 1965 returned to the Museum with more than 2,000 specimens of mammals and over 10,000 samples of the mites, ticks, lice, fleas and batflies found on them. A medical entomologist of the American University of Beirut, Dr. Robert E. Lewis, participated in the Afghan Expedition. The Museum's expedition to Iran in 1962–1963, also led by the Streets, collected over 1,700 specimens of mammals with their assorted ectoparasites. The ectoparasites are being studied by leading authorities at scientific institutions scattered over the world. Mr. Douglas Lay, the mammalogist of the Iranian expedition, has undertaken a taxonomic revision of certain species of gerbils collected on the expedition. Gerbils are small rodents of Asia and Africa and important reservoirs of bubonic plague.

Specimens brought back in recent years by Field Museum expeditions to Borneo, Malaya, Philippines, Sudan, Peru, Colombia, Surinam, Guatemala, Panama and many other lands, make our collections of ectoparasitic arthropods among the finest in the world. The collections of fleas, mites and ticks are outstanding, and the batfly collection is the largest anywhere. Dr. Rupert Wenzel, Curator of Insects and an outstanding authority on batflies, has edited and is now seeing through press a weighty volume entitled "Ectoparasites of Panama." This will be a museum publication comprising contributions by twenty of the foremost authorities in their fields. Cost of much of the research and of publication was supported by the United States Army Medical Research and Development Command.

Interest of medical entomologists in the ectoparasites of Panama began with the classical studies of malaria and yellow fever during the building of the Panama Canal. Most early investigations of arthropod-borne diseases in Panama were directed toward establishment of a healthy environment in the tropics for man and domestic animals. The forthcoming volume "Ectoparasites of Panama," deals more fundamentally with all known ectoparasites of Panamanian land mammals and with the relationships between parasites and their hosts.

Left: *Associate Curator Melvin Traylor sorting a shipment of Asiatic birds. The geographic distribution and migrating route of each species will be determined from the locality and date of capture recorded on the label of each specimen.* Right: *Shaw's gerbil* (Meriones shawi) *from Egypt. One of several kinds of gerbils known to be reservoirs of bubonic plague. Study of the origin, evolution and dispersal of gerbils is one of many Museum research projects.*

COVER: *This month's cover shows a series of study-skins of* Callomys callosus, *prepared in the field by medical workers for the Public Health Service in San Joaquin, Bolivia. The little rodents, identified by the author of this article, were found to be reservoirs of Bolivian Hemorrhagic Fever. Their control produced a dramatic end to the fever.*

BATS AND RABIES.—Bats are also reservoirs of diseases afflicting man and domestic animals. The bloodsucking or vampire bats are the most important vectors of rabies throughout Latin America. Human deaths from bat rabies have been recorded. In some parts of the American tropics, cattle losses from epidemics of this disease have been disastrous. Vampire bats may also transmit rabies to other kinds of bats with which they roost. However the disease may have been transmitted, rabid insectivorous bats have been observed in the United States, Canada, Europe and India, places where vampires do not occur. The late Colin Campbell Sanborn, the Museum's Curator of Mammals until his retirement in 1955, was a world authority on bats and a consultant to the National Institutes of Health in this specialty. His taxonomic revisions of certain New and Old World species and genera of bats published in the Museum's zoological series, are valuable tools in the study and control of bat rabies.

MONKEYS IN MEDICINE AND MUSEUM RESEARCH.—Many human diseases are studied under controlled conditions by using tame laboratory animals such as white mice, rats, hamsters, guinea pigs, rabbits and chicks. These animals are usually of known strains and, in any case, present no taxonomic problems. In recent years, however, there has been an increasing use of captured wild monkeys as laboratory animals, many of them unidentified as to species. A large number of investigators believe that use of nonhuman primates as experimental animals offers a more direct approach to solutions of some of man's own biological problems. The similarities between man and nonhuman primates are real, and stem from a common and not very remote ancestry. The history of primates embraces the story of man's beginning, the evolution of his specializations, notably the ability to reason, his behavior patterns, the history of his parasites, the origins of some of his diseases, the manifestations of their symptoms, and responses to treatment. The more man learns about his primate relatives, the more he learns about himself.

Least known among nonhuman primates are the smaller monkeys which are preferred as laboratory animals. The need for correct identification of each of the many kinds of small monkeys used in medical research is obvious. An experiment cannot be repeated or controlled if its most important ingredient, the experimental animal, is an uncontrolled variable or if its precise identity is unknown.

The medical scientist or biochemist is neither trained nor disposed to deal with intraspecific variables and the taxonomic, zoogeographic and ecological problems posed by the wild caught animals used in his experiments. The field naturalist and museum taxonomist, often one and the same person, is not only so trained but is largely engaged in solving such problems. In some cases, solutions to particular problems are already available in published taxonomic revisions. In the case of nonhuman primates, however, what is known falls far short of meeting the explosive and overwhelming demands for information.

During the last decade the Field Museum has been alone among North American institutions in conducting basic research on the taxonomy of living species of monkeys. Cognizant of the importance of this work to human welfare, the National Institutes of Health, particularly the Cancer Institute, are contributing to the support of the Museum's research in primate taxonomy. Current projects at the Field Museum include a monograph on marmosets (a family of small tropical American monkeys widely used as laboratory animals) and a taxonomic revision of the Old World group of monkeys known as macaques. The medically and pharmaceutically important rhesus is a member of this group.

Left: *The bloodsucking or vampire bat* (Desmodus rotundus) *is the most important vector of rabies throughout Latin America.* Right: *The rhesus macaque* (Macaca mulatta) *is widely used as an experimental animal in behavioral, biomedical and pharmaceutical research. The classification of macaque monkeys is being revised by Museum Associate Jack Fooden.*

INTERDEPENDENCE OF BIOLOGICAL SCIENCES.—Museum scientists do not study illnesses of men or animals. Museum zoologists study and collect animals in the field and classify them in the museum laboratory. Sometimes the examination of only a fragment of the form is sufficient for purposes of identification and classification of little known or extinct organisms. In the case of common living species nearly everything that can be learned about them may be taken into account. Knowledge gained by the taxonomist in classifying animals serves the biomedical investigator in the control and interpretation of research using experimental animals. In turn, what the medical investigator learns about susceptibilities, immunities and other physiological characteristics of his experimental animals, serves the taxonomist in perfecting his system of classification.

FALL LECTURE SERIES

Tea Pluckers
Ralph Gerstle's 'Ceylon'

Basalt Columns
Robert Davis' 'Iceland'

Lake Ohrid
Gene Wiancko's 'Balkans'

Matterhorn
Philip Walker's 'Switzerland'

Dance
Nicol Smith's 'Morocco'

This year's Fall Lecture Series offers film studies on the people, the history, and the natural riches of many areas around the world. The nine films, all in color and all with personal commentary by well-known lecturers, are presented by the Museum as the 126th Series of Illustrated Free Lectures. They will be held in the James Simpson Theatre of Field Museum of Natural History at 2:30 p.m. on successive Saturday afternoons from October 1st through November 26th. Reserved seats for Museum members will be held until 2:25.

October 1—Wildlife at Your Doorstep Howard L. Orians

A film that brings into focus the exciting and delightful world of nature to be found all about us. Rather than ranging far afield, the camera seeks out ever-present wonders close at hand.

October 8—Incredible Iceland Robert Davis

An amazing land enjoying surprisingly temperate climate, democratic government, and a high standard of living. Natural features such as glaciers, waterfalls and volcanoes abound: —the film includes a sequence on the creation of a new island by marine eruption.

October 15—Field Museum Expedition to Afghanistan William and Janice Street

Mr. and Mrs. Street, Field Associates of the Museum, report on their recent zoological expedition to Afghanistan, with color slides.

October 22—Morocco Nicol Smith

From the Moslem Holy City of Moulay Idris to the gleaming new buildings of Casablanca, this film covers the colorful life of the markets, oases, and Islamic and Roman ruins.

October 29—Switzerland Philip Walker

Quaint charm, sophisticated elegance, the grandeur of the Alps and the beauty of lakes—all contribute to this fine film. Features the only complete authentic motion pictures ever made of a free balloon flight over the Alps.

November 5—Ceylon Ralph Gerstle

The richness of tropical jungle and seacoast, the heritage of Buddhism in ancient monument and current practice, and the interesting aspects of the local tea, coconut and mining industries presented by an award-winning film-maker.

November 12—Mysteries of the Balkan World Gene Wiancko

Delves into the fascinating past and colorful present of the people of Macedonia, Montenegro and Albania's mountains. Presents the Gypsies, the Shyptars and the "Children of the Eagle," and their confrontations with "modern civilization."

November 19—Ojibway Country David Jarden

Combines rugged adventure with a look into the unusual life of the Ojibway Indians who live in a Northern Ontario wilderness which has changed little for centuries. The film is based on a canoe trip made by photographer-narrator David Jarden in company with a family of Ojibway Indians.

November 26—Only in Portugal Gerald Hooper

Features on the spot sound recording in addition to live narration. Covers the sights of Lisbon, the resort city of Estoril, religious shrines and native wine, craft and cork industries, plus a capsule view of Portuguese history.

A new Zoology exhibit
in which the tongues of certain birds are used
to illustrate the biological principle of
CONVERGENCE

Austin L. Rand, Chief Curator, Zoology

A MONKEY-FACED owl and an owl-faced monkey of Africa are two "look-alikes," whose convergence in physiognomy is probably due to accident. The rattlesnake's rattle and the tuft of quills on the tip of the tail of the African porcupine are both shaken noisily, a useful convergence to warn away enemies. The brush-tongued honey opossum and the brush-tongued lory, both of Australia, both use the peculiar tongue to feed on nectar and pollen in flowers, a convergence in form and function to use a special type of food.

The conventional view of evolution is one of divergence, radiating to adapt to available habitats. But when the original radiation continues in several phyletic lines, convergence may occur. Reptiles and mammals are branches of a common stock. When each evolved forms for land, air, and water, the reptiles produced four-footed lizards, fish-like Ichthyosaurus (now extinct), and winged pterodactyls (also extinct). Mammals came up with four-footed mice, winged bats, and fish-like whales. This is convergence on a grand scale.

Several groups of small birds sip nectar through a tubular tongue, much as we might drink milk through a straw. Commonly, the bird tongue is flat, and just long enough to fit into the bill. The hummingbirds of the Americas, the sunbirds of Africa and southern Asia, and the honeyeaters of the Australian region are not closely related, yet each has developed an elongated, slender bill for probing into flowers, and an elongated, slender, extensible tongue of which the edges are rolled up to provide tubes through which each can drink nectar. These, hummingbirds, sunbirds, and honeyeaters, and their convergence in relation to flower-feeding, are the subject of a new exhibit at Field Museum.

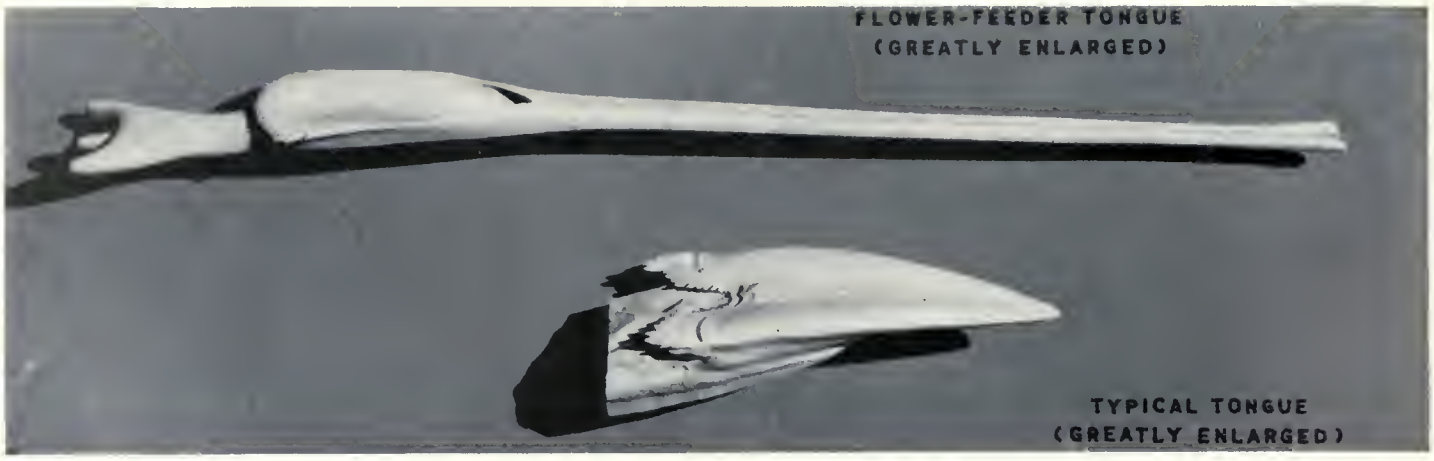
Though each group has a long, tubular tongue, the details of structure are different in each case. In the hummingbirds, the tongue is split lengthwise and the outer margins are curled down to form two separate tubes that lie side by side. In the sunbirds, the edges of the tongue curl up to meet or overlap to give a single tube except at the tip where it is split to form two tubes. In the honeyeaters, the central part of the tongue forms a single tube, as in the sunbirds, but the tip is divided into four parts, each fringed out to give a brush-like tip, a structure lacking in the other two groups. Such fine differences in detail support other differences in structure, habits, and range, so that these birds form three unrelated groups, and the gross similarities in tongue are ones of convergence.

It is all very well to dwell on a small part of these birds, the bill and tongue, to illustrate a biological principle. To divide an animal into many parts and distribute them among specialists for study is the rule today, and is necessary for understanding processes and principles. But we must remember to put the parts together again, to see what the whole bird is like. In line with this, a brief synopsis of each group follows.

HUMMINGBIRDS. All 300 species live only in the New World. They include the smallest of birds, and this feature was stressed when they were first introduced into the literature. This was in 1525, by Oviedo, Governor of Hispaniola, in his "Hystoria general de las Indias," published in Toledo. He called the hummingbirds *paxaro mosquito*, a name that still survives in the French *oiseau-mouche*.

The brilliance of the iridescence is no less remarkable. Many bright colors on birds are likened to the sheen of burnished metals: steel, copper, bronze or gold. But imaginative writers have likened the hummingbird's brightness to that of polished jewels. This is reflected in the gem-words incorporated in their popular names: emerald, sapphire, garnet, berylline, amethyst, ruby, and topaz.

The flight of hummingbirds is unique. They can hover, stationary in the air, move into a flower, or fly backwards out of it, with equal facility. This is due to an unusual socket arrangement where wing bones join those of the shoulder. The wing tip moves back and forth in a sculling, figure-of-



Models of typical bird tongue and flowerfeeding tongue, from new exhibit

eight pattern, with both forward and backward strokes being power strokes. With such unusual development of flight, it is not surprising that the feet are tiny, incapable of locomotion, and used only for perching on twigs.

Of course, not all hummingbirds are small. The largest are as large as sparrows. Nor are all species brilliant, either, and in those that are, it is the male that wears the vivid plumage. Correlated with the pronounced sexual dimorphism, these birds are polygamous, and the female assumes all duties of family life.

The neat cup-nest and the two pure white eggs are wonders of miniaturization. The female feeds the helpless nestlings by injecting them with food, thrusting her long bill well down their throats.

One species, the ruby-throated hummingbird, nests as far north as southern Canada. But a flower-feeder would fare ill in a northern winter. The American Tropics is where most species live and the ruby-throat migrates there for the winter. Despite their small size, they make the more than 500-mile crossing of the Gulf of Mexico.

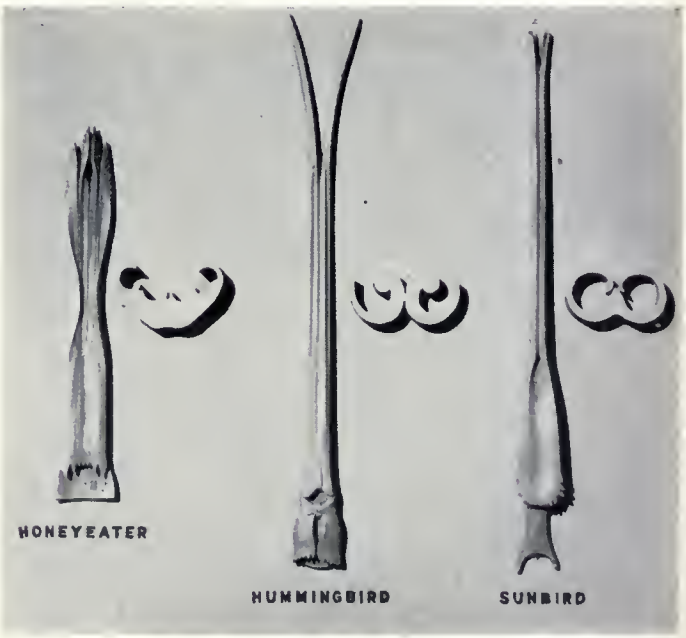
Hummingbirds as a group have their closest relatives in swifts and perhaps nightjars, as indicated by structural details which are as unusual as their habits and appearance. A wide gap separates them from our familiar songbirds.

SUNBIRDS. Their headquarters are in Africa, where most of the 100 species live, but there are a fair number in tropical Asia, and two adventurous far-colonizing species have island-hopped recently (geologically speaking) through the East Indies to reach the Australian area.

Sunbirds are a group of songbirds generally small, of warbler size, that hop and flit through the foliage, and their notable features, aside from flower adaptation, are in the bright, even gaudy, colors of the males. They have some iridescent patches, especially metallic greens and blues, but much of their brightness is due to non-lustrous reds, blacks, yellows, and purples.

Most of the females are dull, often olive-green, but despite this sexual dimorphism the birds sing, form pairs, and both sexes may take part in family duties. The nests are rather unusual. Some are oval, pensile structures with an entrance at the side under a little "porch-roof." Other nests, those of the "spider hunters," are stitched tailor-bird fashion, to the underside of a leaf. As with many songbirds, the eggs are spotted.

HONEYEATERS. An early songbird colonist reached Australia before its competitors did and found a flower-rich habitat vacant. It evolved some 160 species to take advantage of this vacant food niche, just as certain brush-tongued lories and certain brush-tongued opossums did. While many flower-feeding hummingbirds and sunbirds evolved bright colors to rival the flowers at which they fed, so that one is tempted to suggest a further correlation, the honeyeaters, which feed much like sunbirds, did not, and bright colors are an exception. The breeding biology is that of typical songbirds, with pairing, a cup nest, spotted eggs, and both sexes sharing nest duties. That the honeyeaters have been successful there is no doubt, if one judges by their numbers of species



Models and cross-sections of the tongues of the Hummingbird, Sunbird and Honeyeater

and abundance. In a country where there was little competition they radiated more in size than did either of the other groups we have discussed, and as well as tiny species there are some that are as large as jays and feed in part on fruit. But all retain the four-part tip to their tongue, indicative of their common ancestry.

The idea for this exhibit grew out of a luncheon conversation with Miss Frances Hooper of the Women's Board of the Museum in which we discussed Miss Hooper's fascination with the beauty, small size, diversity, and bizarre habits of hummingbirds. A plan for an exhibit of hummingbirds and their ecological counterparts on other continents developed. Now we have a permanent exhibit illustrating the Biological Principle of Convergence on view in Boardman Conover Hall, Hall 21.

The scope of the thinking involved in planning this exhibit went far beyond the birds and flowers actually involved. Since starting this exhibit I have given a lecture on convergence for a University of Chicago class, and as I have indicated above, forms as diverse as fossil reptiles and honey opossums can be used as examples. Beyond that I have surveyed the whole subject of nectar adaptation in songbirds and its importance in evaluating taxonomic evidence. A research report on this entitled, "The Flower-Adapted Tongue of a Timalinae Bird and Its Implications," is approaching publication in Field Museum's series *Fieldiana: Zoology*.

When we install a proposed hall devoted to "Ecology and Evolution," we hope to devote a section to exhibiting the whole scope of convergence, how similar adaptations in unrelated groups result in "look-alikes."

LIBRARY DISPLAYS BOOKS ON BIRDS

Field Museum Library this month has a special exhibit of rare books from the Edward E. Ayer Collection, relating also to birds. Mr. Ayer was the first President of the Board of Trustees of Field Museum, and among his first acts as President was the presentation of his ornithological library.

Among the books on display is a first edition of *A Natural History of Uncommon Birds* by the noted English naturalist George Edwards (1693–1773). The book has many colored plates and descriptions of the birds in French and English. It is even more noteworthy because it once belonged to the Welsh naturalist Thomas Pennant, and has many marginal notes in his hand.

A curious old work, *Il Canto de gl'Avgelli*, by Antonio Valli da Todi, published in 1601, is also displayed. The book, on songbirds and methods of catching and keeping them is illustrated with woodcuts, signed "Johannes Maivs," and beautifully bound in crimson morocco, with gold tooling.

The exhibit was prepared by Carl Zangerl, a summer assistant in the library. It represents only a small part of the Ayer collection. Probably no other branch of science has produced so many sumptuous and profusely illustrated books as ornithology. Their cost is usually prohibitive to all save the largest and finest libraries. It has been Field Museum's good fortune since its inception to possess many of the finest works on birds.

SPECIAL DELIVERY

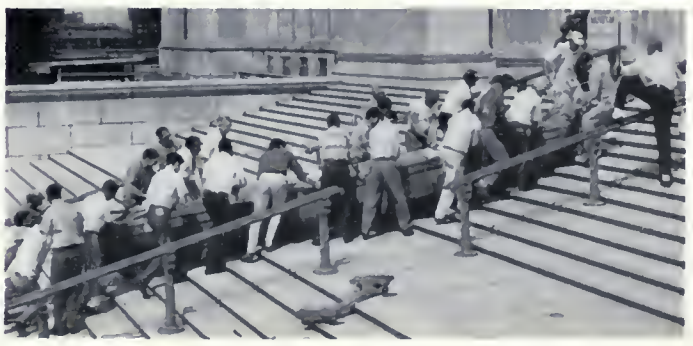
LAND HO Voyager Brenton enters Burnham Harbor

The *Sierra Sagrada*, a curious, jury-rigged craft, made of two South American Indian dugout canoes connected by a hand made wooden frame, arrived recently in Burnham Harbor, near Field Museum, escorted by the Chicago Police boat *Morris Friedman*. A Chicago adventurer, Francis Brenton, 39, had piloted the vessel from Cartagena, Colombia, across the Caribbean and the Gulf, up the Mississippi and Illinois Rivers, and practically to the Museum's front door.

Brenton had been commissioned some months ago by Chief Curator of Anthropology Donald Collier to purchase a dugout canoe for the Museum's collection. Brenton bought two, one a 26-footer at Santa Marta, Colombia, and a 22-footer made by the Cuna Indians of San Blas Islands, Panama. They were made from the hollowed-out trunks of the tropical *espavé* (*Anacardium excelsum*). Brenton's mode of delivery was unusual. He fashioned the masts and the wooden framework connecting the two boats himself, with only a saw and an ax. Then, he provisioned the *Sierra Sagrada* and set sail for Chicago. 81 days and 3,000 miles later astonished Museum officials greeted Brenton at the Burnham Yacht Club. The most dangerous part of the trip was skirting Hurricane *Alma* in the Gulf of Mexico, but the most unpleasant period, said Brenton, who rather enjoyed the brush with *Alma*, was a period of 24 days of dead calm.

The canoes have been set up in Stanley Field Hall exactly as they were during Brenton's voyage, and have attracted thousands of viewers.

Sierra Sagrada appears to mean "Sacred Mountains"; however, its captain has assured Field Museum that *sierra* in American Spanish also means fish, and in Colombia it is widely used to mean "mackerel." The name of the craft, then, given it by the builder, is "Holy Mackerel." Most BULLETIN readers will probably concur in that sentiment.



YO HEAVE HO Museum canoe specialists work with a will

TEENAGERS STUDY INDIAN SITE

Flossmoor dig is climax of Summer Program

Learning by doing, as well as through textbook and classroom lecture, made Field Museum's Summer School in Anthropology a complete educational experience for the 25 specially-qualified high school age students who participated. The excitement of discovery gave an added fillip to the whole process, when during a week-long dig near Flossmoor the youngsters turned up arrow and spear points, pounding stones, deer and wildfowl bones and clear-cut dark circles left by lodgepoles in yellow sub-soil clay. Stuart Struever, of the Department of Anthropology of Northwestern University, who with Museum staff members Harriet Smith and Edith Fleming headed the "dig," told the youngsters that their exciting finds had been of Indian winter communities during the period 1450–1650 A.D. Excavations were on a meadow near Butterfield Creek, in an area soon to be bulldozed in preparation for housing construction. The 25 young archaeologists and their instructors worked in broiling sun and soaking downpour with only the shelter of a nearby Norway maple (see above site photo). They worked first with shovel, then below the six-inch plough line, gently and delicately by trowel. All soil was screened in search of artifacts and evidence of Indian occupation (in photo from left, Theresa Gentry, Mary Doria, John Simon, Kevin Sullivan and Susan Teshima). Shown measuring the location of a posthole (note dark circle in the clay) are Heidi Thompson and James Demopulos. Miss Miriam Wood, Chief, Raymond Foundation, Field Museum, directed the program, which was supported by National Science Foundation.

CALENDAR OF SEPTEMBER EVENTS

September through November FALL JOURNEY "MASKS," features American Indian masks, showing through exhibits how they were made and used for healing, rainmaking and inspiring fear. Direction sheets for this self-guided tour are available at the Museum Information Desk.

September Meeting ILLINOIS ORCHID SOCIETY. September 18 at 2 P.M. The Annual Orchid Show, November 19–20, at Field Museum will be discussed.

Open to members and interested non-members.

WORKSHOP (*continued from page 2*)

OCTOBER 29

10:30 A.M. for ages 10–13

Understanding the Earth's Features

Ernest Roscoe

A movie reviews the changes which have occurred on the earth's surface over the last half billion years. Work in exhibition halls covers processes which are going on all around us to change the earth's surface.

1:30 P.M. for ages 10–13

Life Through the Ages

Ernest Roscoe

Two of the topics covered in this workshop will include: how plants and animals become fossils; how to identify the major groups. Emphasis on those groups found in the Chicago region will be stressed. Session will include a movie and work with specimens.

10:30 A.M. and 1:30 P.M. for ages 8 and 9

What Is It? Animal or Vegetable?

Marie Svoboda

This workshop will ask boys and girls the question, "What is it . . .?" A grab bag filled with mysterious objects to be touched or tasted or smelled will be the main attraction. "No fair peeking!" Boys and girls who participate need no paper or pencil—only hands, noses, and taste buds. A short tour in the exhibition halls will be included.

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT ROAD AT LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605 A.C. 312, 922-9410
FOUNDED BY MARSHALL FIELD, 1893

E. Leland Webber, Director

BULLETIN

Edward G. Nash, Managing Editor
Beatrice Paul, Associate Editor

PRINTED BY FIELD MUSEUM PRESS

Volume 37, Number 10 October, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

SUMMER SCHOOL IN THE DESERT

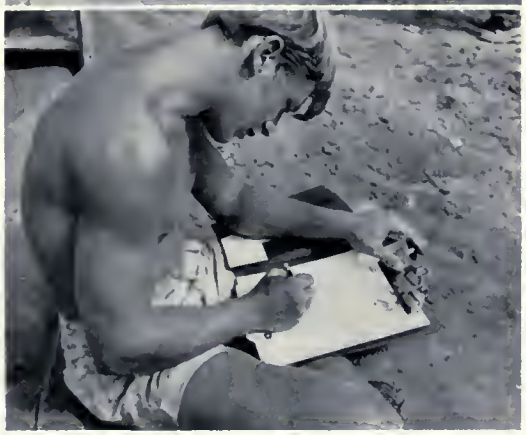
High ability undergraduate students for the last two years have participated in a summer school of practical and theoretical archaeology at Field Museum's Field Station, Vernon, Arizona. This past summer, photographer James Ballard spent eight weeks working at the Station. In this issue, the BULLETIN presents his photographic report on life at Vernon.

The station is some 7,000 feet above sea level, and it is sometimes near 40° as the men shave and prepare for the day's work. By lunch time, the desert air has heated to 98° in the shade—if there were shade.

The day in the field begins with a Brandenburg Concerto at 6 AM. On a loudspeaker, Bach is as effective as a bugle and, no doubt, a more valuable cultural experience. After breakfast (COVER) and morning chores, the trucks are loaded for the fifty-mile trip to the site.

Chief Curator Emeritus of Anthropology Paul S. Martin has worked in the American southwest for nearly forty years. His published reports on archaeological sites in New Mexico, Colorado, and most recently, eastern Arizona have filled a dozen volumes in the Museum's scientific series *Fieldiana: Anthropology*. Martin has always had students at his dig, many of whom are now prominent on Anthropology faculties across the country. A National Science Foundation grant two years ago allowed him to adopt a more formal educational program in connection with his research into Southwestern prehistory. This year, 16 undergraduates and graduates came to Vernon, population twenty-five. Nearest large towns are Flagstaff, Arizona, and Gallup, New Mexico, both over a hundred miles across the desert.

Dr. Martin and Chris White check erosion data for the area. Students were responsible for individual research projects as well as the general work on the dig. White worked on soil analysis. *Below,* students use a tetrapod sifter.



The 1966 site was called Hay Hollow. A village of five houses was excavated. 200 storage pits were dug and the contents sifted for material remains. The work combines classical methods of archaeology with modern techniques of statistics, chemical soil analysis and fossil pollen studies, to determine not only the details of the society, but also the climate and wildlife at the time the site was occupied. *At top,* John Fritz surveys the area; *beneath,* a student measures a storage pit in preparation for sectioning. The arrow points north and the meter stick indicates scale for the photographic record.

Middle photograph shows two students carefully excavating storage pits. Charcoal found in the pits gave radio-carbon dates ranging from 500 B.C. to A.D. 200, thus giving the tentative time range of site occupation. *Above, left,* Robert Blankmann takes notes on the distribution of bifacial stone tools, such as knives and scrapers, collecting data for his research project. *Right,* student Brantley Jackson uses a sifting table, searching for stone artifacts.

The students worked long and hard on their individual research projects. John Zillen checks the distribution of fire-cracked rock from the site. Presence of this rock enabled the party to predict the location of cooking activities and then dig for fire-pits.

Above, Thomas Volman reports on his work. Volman studied stone grinding tools found at the site. The Indians used these tools to grind corn, nuts, grasses—as well as decorative pigments.
Bull sessions among students and staff helped clear up many questions. Conversation in the bunkhouse, *right,* took place before an exam.

Top, student plotting results of field data on site map. *Above,* Dr. Martin looks on as students use an aerial survey map of Hay Hollow to locate the various geological features of the area.

Among the five guest lecturers who came to the Field Station was Dr. Douglas Schwartz of the University of Kentucky who talked about problems involved in making cultural inferences from archaeological data.

Don Crabtree, Idaho State University, is one of two men in the world able to chip stone tools exactly like stone age tools. A set of stone skinning tools made by him this summer were used to skin a bear.

Miss Vorsila Bohrer, University of Arizona, lectured on the uses of fossil pollen in site analysis, indicating that the shape of a grain of pollen provides clues to climate.

The group visited the University of Arizona Field School at Grasshopper, Arizona, supervised by Assistant Professor William Longacre, a former student and associate of Dr. Martin, who spent six summers with Martin in the field. *At right,* students examine the Grasshopper site, a pueblo of a later era than the Hay Hollow site.

Participation in community activities was an important part of the life at the Field Station; *below,* student I. B. Remsen plays guitar at Vernon Day celebration.

At left, Bud Alcock in a universal student pose. *Above,* Robert Blankmann compares notes with Grasshopper girl.

An evening bull session on the day's work. Dr. Martin and students listen as former Vernon student Dr. James Hill, now Associate Director of the Summer Program and Assistant Professor at UCLA, makes a point.

The response to the summer program, which has been supported by the Undergraduate Research Participation Program of National Science Foundation, has been enthusiastic. The program provides an introduction to field work which many students formerly did not receive until well along in their graduate training. The educational value to the students is balanced by their own contributions to the continuing work on the prehistory of the American Southwest.

Sheep dot
an Afghan hillside

Afghanistan

BY AUSTIN L. RAND, CHIEF CURATOR, ZOOLOGY AND JERRY D. HASSINGER, SENIOR EXPEDITION FELLOW

The most important scientific mammal collection ever made in Afghanistan is the result of the 1965 Field Museum expedition financed and led by Mr. and Mrs. William S. Street. Two thousand specimens of about 86 species were shipped to the Museum for study. These represent all parts of Afghanistan and will become a permanent part of the world's collections. Senior Expedition Fellow Jerry Hassinger is now engaged in the preparation of a general account of the expedition and a scientific report on the terrestrial mammals. The present article is a general overview of the kinds of mammal life to be found in Afghanistan, and those actually collected by the expedition.

AFGHANISTAN LIES SANDWICHED between Soviet Russia and West Pakistan, where the western end of the great mountains of Asia tail away to the Persian plateau. It is a country of great mountains and deep valleys, the highest peak reaching 23,000 feet and the lowest point occurring at only 500 feet, for Afghanistan does not descend to the sea. The low rainfall, 3 to 20 inches a year, falls mostly in winter. Thus this land, with its huge stretches of steppe and desert, is part of the great arid belt that runs from Arabia to the Gobi Desert of Mongolia. Much of Afghanistan is treeless, except in oases or in the mountains of the east, which receive some rain from the Indian monsoons. View after view recalls the scenery of our American West.

The strategic position of Afghanistan has invited both the inroads and influences of other cultures through the centuries. The Greeks under Alexander marched through; Genghis Khan and his Mongols invaded in the 13th century; the old silk route that ran from Peking to Damascus had branches here; troubles with tribesmen led the British to force the Khyber Pass in the early 19th century. Today, Russia and the United States are both engaged in aid programs.

Just as the country's geographic position has made it a crossroads of history and culture, it has also acted to draw animal life from neighboring faunal regions. Most zoogeographers place the fauna of Afghanistan in the same general region as that of the temperate and arctic zones of Asia, Europe and North America—the Holarctic. In addition, Afghanistan lies close enough to the southern edge of the Holarctic zone to receive influxes from two other faunal regions, the Oriental of India, and the Ethiopian of Africa and Arabia. It was this varied fauna, reflecting influences from several regions, that the Street expedition set out to study.

Many of the animals observed by the expedition are familiar to American eyes. Among these the wolves, red foxes, and weasels are actually of the same species we have. Others of different species, but similar enough to be recognized, include a hare (much like our jack rabbit), a pika (like the little rock rabbit that stores hay in the Rockies), a ground squirrel, a marmot (very like our woodchuck), a vole (a meadow mouse type), a lynx (plainer and with larger ear tufts than ours), and a red deer (similar to our elk). There is also a bear which, like our black bear, comes in color phases.

Among animals familiar to Europeans is the hedgehog, a prickly beast that rolls into a ball for protection when disturbed. It was commonly seen on Afghan roads and was given special attention by the expedition's Medical Entomologist, Dr. Robert E. Lewis of Beirut because of the abundance and variety of its ectoparasites. Sana Atallah, Expedition Preparator, skinned what is surely the world's most valuable collection of this spiny species.

The cats are represented by the tiger of India, the snow leopard of Asia and four wildcats which are more like our domestic tabby than our bobcat.

-report on fauna from the Street Expedition

A rather peculiar mustelid is the marbled polecat, dark brown marbled and spotted with white, which only vaguely recalls our spotted skunk. It is alleged to rob graves. The expedition found it secretive; the only specimen taken was killed by a workman with a shovel.

Among the hoofed animals encountered, is a honey-colored donkey, the onager, with a narrow black dorsal stripe. A wild boar occurs, similar to that of Europe, and like the one introduced into the Tennessee mountains for hunting. In neighboring Pakistan, these animals are on the increase and have been quite harmful to crops. The pale, slender gazelle of the desert recalls Africa, where the group has many species. There are three species of goats: one probably involved in the ancestry of our domestic goat; one with long, spirally-twisted horns; and another, the ibex, with a magnificent sweep of horns, whose range reaches west as far as Spain. The sheep with the finest horns in the world—Marco Polo's sheep—occur in the Russian Pamirs and in the far northeast of Afghanistan. The expedition was unable to secure a specimen of this species, and got only the common species which is probably involved in the ancestry of domestic sheep.

Rodents are often equated only with rats and mice. Afghanistan has its share of these, but there are other types of rodents as well. Of these, the porcupine is the most striking. It is prickly like our porcupine, but more so. It has a greater number of quills, some of which reach 12 inches in length. The desert jerboas are remarkable, long-tailed, jumping rodents recalling the kangaroo rats of the United States. This similarity is due not to relationship, but to convergent adaptation to desert conditions. Seldom are rodents or their works conspicuous, but the Afghan great gerbil (*Rhombomys*) is an exception. Though a rather undistinguished, pale colored, rat-like animal, its burrows in the hillsides are so plentiful that in places they give a conspicuous pattern of dots to the terrain. Often these slopes are further marked by horizontal lines of the trails worn by countless sheep.

Among the smaller rodents is a subterranean vole, with a mole-like fur (moles do not occur here). The migratory hamster is related to the golden one that has found favor both as a children's pet and as a laboratory animal for experimental purposes. The dormouse, a climbing mouse with a bushy tail, is perhaps most widely known for sleeping through the Mad Hatter's tea party in "Alice in Wonderland." Its name derives from the fact that it hibernates through the winter.

In the holly oaks and cedars of the mid-altitudes of the eastern part of the country, the monkey *Macaca mulatta* still occurs. This is the common monkey of experimental laboratories. One difficulty in getting specimens was that, despite its destruction of crops, the local people fear it. They believe that if one is killed, the remaining monkeys will assemble to wreak their vengeance. The species is Indian, and is at the northwest limit of its range here.

The hyena, on the other hand, of an African group reaching to India, approaches the *northeastern* limit of its range in Afghanistan. Afghans use hyenas for sport, catching them alive and pitting them against dogs in their form of "bear baiting."

The many species of bats, perhaps three dozen, from caves, rock crevices, and houses, are very confusing. One can see that some are larger, some smaller, some paler or darker, with long or short ears, with complicated or simple fleshy patterns about the nostrils. A special report on these creatures is being prepared by Expedition Fellow Hans Neuhauser.

It is likely to require many additional months of study to deal with the large quantity of material brought back from Afghanistan by the Street Expedition. These specimens have added notably to the Museum's collection of source material on this zoogeographically interesting area.

CALENDAR OF OCTOBER EVENTS

October hours, 9 a.m. to 5 p.m. every day. Admission free to members and their guests.

October through November Fall Journey, Masks
Features American Indian masks, showing through exhibits, how they were made and used for healing, rainmaking and inspiring fear. Direction sheets for this self-guided tour available at information booth.

October 1–31 Art Forms in Nature, a High School Exhibit
Work produced in this summer's "Action Seminar in Art," a Board of Education program for selected students from Chicago Public High Schools. Mosaic, tie-die, batik and stitchery are shown in Hall 9 Gallery.

October 1 Movie: Wildlife At Your Doorstep
Close-up look at the world of nature with commentary by Howard L. Orians.

October 8 Movie: Incredible Iceland
Robert Davis speaks on his film of this surprising country.

October 15 Slide show: Field Museum Expedition to Afghanistan
William and Janice Street discuss color slides of their zoological expedition.

October 22 Movie: Morocco
The country's ancient past and present in a film narrated by Nicol Smith.

October 29 Movie: Switzerland
Philip Walker speaks on this land of variety and contrast.

Programs at 2:30 p.m. in James Simpson Theatre; members' reserved seats held until 2:25.

OCTOBER MEETINGS

Meetings open to members and interested non-members.

Chicago Shell Club, October 9 at 2 p.m.
Dr. Alan Solem, Curator, Lower Invertebrates, will discuss shell names.

Illinois Orchid Society, October 16 at 2 p.m.

Illinois Audubon Society, October 30 at 2:30 p.m.
Inherit the Wind, a D. J. Nelson film, will be shown.

FASHIONS BENEFIT RAYMOND FOUNDATION

The children participating in Field Museum educational programs were the prime beneficiaries of Marshall Field & Company's premiere presentation of its Fall 1966 Designer Collection. The show, which was arranged jointly by Marshall Field & Company and the newly organized Women's Board of Field Museum, was the principal fashion event of the autumn season. The showing was widely reported and commented upon in the press and on television. Presented in early September in the Mayfair Room of the Sheraton-Blackstone Hotel, it was preceded by cocktails and luncheon.

Mrs. Gordon Lang headed the committee of the Women's Board which made

Mrs. Gordon Lang, Benefit Chairman. At right, *models show a part of the collection against a background depicting the Sir John Soane Museum in London.*

arrangements and handled invitations and ticket sales. She was assisted by Mrs. Gaylord Donnelley, benefit co-chairman, and Mrs. Wallace D. Mackenzie, publicity chairman. The entire proceeds went to the Raymond Foundation, an educational division of Field Museum.

THREE NEW TRUSTEES NAMED

Three new members were named to the Board of Trustees of Field Museum at the Board's September meeting. They are William R. Dickinson, Jr., Marshall Field and Gerald A. Sivage.

Mr. Dickinson, president of the Chicago Zoological Society, is secretary of the Hospital Association of Lake Forest and of the Schweppe Foundation, a director of Children's Memorial Hospital and on the Lake Forest Board of Education. He is a partner in the legal firm of Wilson & McIlvaine.

Wm. R. Dickinson, Jr.

Marshall Field

Gerald A. Sivage

Mr. Field, who is the fifth of his name to serve the Museum, returned to Chicago last year, after military training and work with the *New York Herald Tribune*, to become assistant to the general manager of the Newspaper Division of Field Enterprises, Inc. His great-great-grandfather, Marshall Field, founded the Museum and was one of its principal benefactors. Mr. Field is the fourth Marshall Field to have served on the Board.

Mr. Sivage, president of Marshall Field & Co., is a trustee of Northwestern University, Carroll College and the Orchestral Association. He was named president of Marshall Field & Co. in 1964, the ninth man to hold that office.

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT ROAD AT LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605 A.C. 312, 922-9410
FOUNDED BY MARSHALL FIELD, 1893
E. Leland Webber, Director
BULLETIN
Edward G. Nash, Managing Editor
Beatrice Paul, Associate Editor

Volume 37, Number 11 November, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

Among the most famous of the 18th century naturalists was the artist-ornithologist to whom the great Linnaeus wrote, "Your performances are

Allegorical frontispiece and facing title-page of George Edwards' A NATURAL HISTORY OF UNCOMMON BIRDS
The seal on the title-page is the Copley Gold Medal, which the Royal Society awarded him in recognition of this work.

an ornament to the age in

—FROM THE MUSEUM'S

GEORGE EDWARDS WAS born at Stratford, in Essex, England, on April 3rd, 1694. His parents had decided on a business career for him and apprenticed him to a tradesman. In the middle of this term of apprenticeship his master fell heir to a large collection of books that had been gathered together by one of his relatives, a well-known physician. These books were housed in Edwards' room and the perusal of them turned his interest from trade to literature and science. In the rare volume that is the source of much of our information about him, *Some memoirs of the life and works of George Edwards* (London, 1776), published and probably written by the bookseller J. Robson, we learn that "He availed himself of this unexpected incident, and passed all the leisure of the day, and not infrequently a considerable part of the night, in turning over this collection of natural history, sculpture, painting, astronomy, and antiquities."

Upon the expiration of his apprenticeship he decided to travel into foreign lands "to improve his taste, and enlarge his mind." He visited Holland in 1716, and in subsequent years, Norway and France. In the latter country he journeyed on foot to Orleans and Blois "in a disguised habit" to avoid robbers and highwaymen. Unfortunately, an edict was issued at that time "to secure vagrants, in order to transport [them] to America, as the banks of the Mississippi

A
NATURAL HISTORY
OF
Uncommon BIRDS,
AND OF
Some other Rare and Undescribed ANIMALS,
QUADRUPEDES, REPTILES, FISHES, INSECTS, &c.
Exhibited in Two Hundred and Ten COPPER-PLATES,
From Designs copied immediately from NATURE, and curiously coloured after LIFE.
With a full and accurate Description of each FIGURE.
To which is added,
A Brief and General Idea of DRAWING and PAINTING in *Water-Colours*; with Instructions for ETCHING on Copper with *Aqua Fortis*: Likewise some *Thoughts* on the PASSAGE OF BIRDS; and ADDITIONS to many of the SUBJECTS described in this WORK.
In Four PARTS.
By GEORGE EDWARDS,
Library-Keeper to the Royal-College of PHYSICIANS.
G. COPLEY BART. DIGNISSIMO.
SOCIETAS REGIA LONDINI.
M. B. EDWARDS 1740
649.30
LONDON:
Printed for the AUTHOR, at the *College of Physicians*, in *Warwick-Lane*.

which we live."

RARE BOOK COLLECTION, THE WORKS OF GEORGE EDWARDS, BY W. PEYTON FAWCETT, ASSOCIATE LIBRARIAN

wanted population; and our author narrowly escaped a western voyage."

Once safely back in England he applied himself to the study of natural history and to the practice of drawing and coloring from nature. His early essays in drawing birds were so well received that he was encouraged to continue and gradually, by the sale of his work and by teaching, he obtained a good living and a large number of friends and patrons.

One of the latter, Sir Hans Sloane, President of the College of Physicians of London and physician to the king, recommended Edwards for the position of Library-Keeper, or librarian, of the College. He was appointed in December, 1733, and given rooms in the College. "This office," we read, "was peculiarly agreeable to his taste and inclination, as he had the opportunity of a constant recourse to a valuable library, filled with scarce and curious books on the subjects of natural history, which he so assiduously studied."

In 1743 he published, somewhat reluctantly, the first part of his *A natural history of uncommon birds, and of some other rare and undescribed animals*, containing engravings and descriptions of 61 birds and 2 quadrupeds, most of which had not been delineated or described before. He tells us in his preface: "I was discouraged, upon first thinking of this work, at the great expense of graving, printing, and other things, which

I knew would be a certain cost attended with a very uncertain profit, [until] my good friend Mr. Catesby (Mark Catesby, 1680?–1749, the author of the celebrated *Natural history of Carolina, Florida, and the Bahama Islands*) put me on etching my plates myself, as he had done in his works; and not only so, but invited me to see him work at etching, and gave me all the necessary hints and instructions to proceed. . . . When I had practiced a little while, I resolved to do such new and uncommon birds as I had in my possession, since I saved expenses and only employed my time."

His fears proved groundless, for the work was a great success. He still, however, retained his reluctance to publish and seems to have considered each part of this work the last. Part 2 appeared in 1747; part 3 in 1750; part 4 in 1751. A French translation "for the use of foreigners" was subsequently issued for each part.

The final part of this work is particularly famous for its dedication: "To God . . . By his most resigned, low, and humble creature, George Edwards." This has shocked some people and amused others; partially, I think, because the dedication is in part 4, the others being dedicated to 1, The President and Fellows of the Royal College of Physicians; 2, Sir Hans Sloane; 3, The President, Council, and Fellows of the Royal Society. Edwards explains in his preface that "if a man would offer any thing to the Supreme Being of the Universe, that is the mere production of his mind, I think what is last produced by him ought to be accounted the most perfect; for which reason I have offered and dedicated to God the last work of this kind that I intend to perform."

For this work he was voted the Copley gold medal by the Royal Society, given annually to the author of any new discovery in art or nature. A few years later Edwards was elected a fellow of the Royal Society and of the Society of Antiquaries, London. He was also made a member of various continental academies of science and learning.

His *A natural history of uncommon birds* was not, however, to be Edwards' last production of this kind. In 1758 he continued the work, for obvious reasons under a new title: *Gleanings of natural history*, with text in French and English in parallel columns. Part 2 appeared in 1760. He gives us, in the preface to it, a wonderful insight into why he found it necessary to continue: "Tho' I have no design to publish any thing more in natural history, yet sometimes, when new and curious subjects offer themselves, my strong passion for that study makes me desirous to take drawings of them. . . ." In this same preface he makes this petition to God: ". . . that he would remove from me all desire of pursuing natural history, or any other study, and inspire me with as much knowledge of His Divine Nature as my imperfect state is capable of. . . ." This was not to be, for the third and final part followed in due course, being published in 1764. Here he makes his last farewell, "my age requiring it."

In 1769 he resigned his office, purchased a little house in Plaistow, Essex, and sold the remaining copies and the plates of all his works to J. Robson. The following year Robson brought out a volume titled *Essays* which consists chiefly of the prefaces and introductions to Edwards' works, to which were added instructions for drawing, painting, and etching. His last years were spent quietly among his friends.

Our library possesses a letter of his to the Welsh naturalist, Thomas Pennant (1726–1798), dated March 26, 1772, that gives us a touching picture of him in old age: "Good sir. If you remember, I promised to bequeath you a large oil painting of the American pelican by Cha: Colings, but I have considered that it may give you some trouble to procure it after I am departed this life. I choose rather to send it directly to any place in London where you would have it lodged. I am obliged to remove from Physicians' College to make room for a person lately chosen into the office [i.e. librarian] who wants the whole apartment for his family. In moving my things I believe there are some odd things that you would like to have, and I [am] unwilling they should be swept away to brokers after my death. I am obliged to you for your kind inquiry after my health by your engraver. Your [tour] in Scotland [i.e. Pennant's *A tour in Scotland*] has yielded me more agreeable entertainment than any book of the kind published of late years. If you will please to favor me with a line or two, the picture above said shall be lodged as you direct. After the first of May I shall be at my house at Plaistow in Essex. In the meantime, or at any time, post letters will be taken in directed to me at the College of Physicians, London. I hope this will find you and your family in good health. I remain, good sir, your obliged and most humble servant, George Edwards." He died, of cancer, at Plaistow on July 23rd, 1773, aged 79.

Our library is the fortunate possessor of a rich collection of Edwards' works. They are part of the magnificent library of ornithological books given to the Museum by Mr. Edward E. Ayer, the first President of the Board of Trustees. Most of the information to follow is culled from John Todd Zimmer's excellent *Catalogue of the Edward E. Ayer Ornithological Library* (Chicago, 1926).

Our copies of the first editions of *A natural history of uncommon birds* (1743–51) and *Gleanings of natural history* (1758–64) are of unusual interest in that they belonged to Thomas Pennant and contain many notes and some personalia. The Latin name of each species of bird, according to John Latham's *Index ornithologicus*, is written in at the bottom of each plate in Pennant's hand, and a manuscript index of these names is laid in. The set is enriched with several extra plates, including one, "the great pied mountain finch or bramlin, 1739," which Pennant cites as "Edwards first essay towards etching a bird." The letter previously quoted is also included.

The library possesses a second edition of both titles with the same dates on the title-pages, but with many changes in the text. The illustrations, if any were published with this edition, are lacking and are replaced by water-colored copies by an unknown artist. The French translation of *A natural history of uncommon birds*, *Histoire naturelle d'oiseaux peu communs* (London, 1745–51) is bound in with this set.

A posthumous edition of Edwards' two works, dated 1802–03, but probably published in 1805 or 1806, is in our collection. Only 25 copies of this "large paper" edition were issued.

A German translation, by G. L. Huth, of Edwards' two works, together with Catesby's *Natural history of Carolina*,

Good Sr

If you remember I promised to bequeth you a large Fol: painting of the American Pelican by Cha: Collings but I have considered that it may give you some trouble to procure it after I am departed this life I chuse rather to send it direcly to any place in London where you would have it lodged. I am Obliged to remove from Physicians College to Make room for a person lately chosen into the Offic who wants the Whole apartment for his Family. In mooving my things I beleive there are some old things that you would like to have, and I unwilling they Should be swept away to Broakers after my death. I am Obliged to you for your kind inquirey after my helth by your Engraver. Your Sr in Scotland has yealded me more agreable Entertainment than any book of the kind Published of late years, if you will pleas to favour me with a line or two the picture abou said shall be lodged as you direct. after the first of May I shall be at My House at Plaistow in Essex, in the meantime or at any time Post Letters will be taken in directed to Me at the College of Physicians London. I hope this Will find you and your family in Good helth I remain

Good Sr your Obliged and Most Humble Servant Geo Edwards

March. 26. 1772.

Thomas Pennant cites the great pied mountain finch (left) as Edwards' "first essay towards etching a bird." The original is bound into the Library's copy of "History of Birds," once owned by Pennant. Below, a characteristic letter from Edwards to Pennant, written in 1772.

Florida, and the Bahama Islands, was published in Nuremberg between 1749 and 1776 as *Sammlung verschiedenen auslandischer und seltener Vogel*. We do not have a copy of this work, but we do have a Dutch translation of it. It was translated by Martinus Houttuyn and published in Amsterdam, 1772 to 1781, as *Verzameling van uitlandsche en zeldzaame vogelen*.

Also included in our collection is the volume of memoirs mentioned earlier. With it is bound Linnaeus' *A catalogue of the birds, beasts, fishes, insects, plants, &c. contained in Edwards's natural history* (London, 1776).

In the preparation of these works Edwards set himself two main goals: to produce text and plates that were accurate, and to produce at the same time plates that were aesthetically pleasing. As a naturalist, he writes "They who draw after nature, on account of natural history, should represent things justly and according to nature. . . ." The text should also conform to this rule. "In describing natural things nothing ought to be omitted, that is any way remarkable, and may fix and establish the character of the thing described, so as plainly to distinguish it from all other things. . . ." The information given should be based on observation and should be written up as such. Information received from others or derived from books should be properly cited so that it can be verified. As an artist, he writes, "I have made the drawings of these birds directly from nature, and have, for variety's sake, given them as many different turns and attitudes as I could invent: this I chose the rather to do, because I know great complaint hath been made, that a late writer on birds had given his birds no variety of posture, but that they were direct profiles standing in the same position, which sameness is disagreeable. I observed also in his trees, stumps, and grounds, a poorness of invention; therefore to amend that part in mine, I have taken counsel and assistance of some painters my particular friends, in order to make the work not only as natural and agreeable as I could in the subject matter, but to decorate the birds with airy grounds, having some little invention in them: the better to set off the whole, I have in a few plates, where the birds were very small, added some foreign insects to fill up the naked spaces in the plates . . ."

How well he succeeded is best summed up, I think, by Linnaeus. In a letter to Edwards, dated March 20th, 1758, thanking him for a gift of some pre-publication plates, he writes "Nothing can more conduce to the advancement of solid natural knowledge, than such beautiful and excellent figures, accompanied by such exact descriptions." Again on April 13th, 1764 he writes "I congratulate you on the acquisition of such beautiful and innumerable rare birds, beyond what any other person has seen, or is likely to meet with; still less is any other hand likely to equal your representations, in which nothing is wanting to the birds but their song. Yet even these will sing your praise, as long as birds or men endure."

BIERIG COLLECTION OF ROVE BEETLES

One of the notable research collections of the Division of Insects, that of the rove beetles or Staphylinidae, has been augmented by the recent acquisition of the Alexander Bierig Collection, numbering about 26,000 specimens.

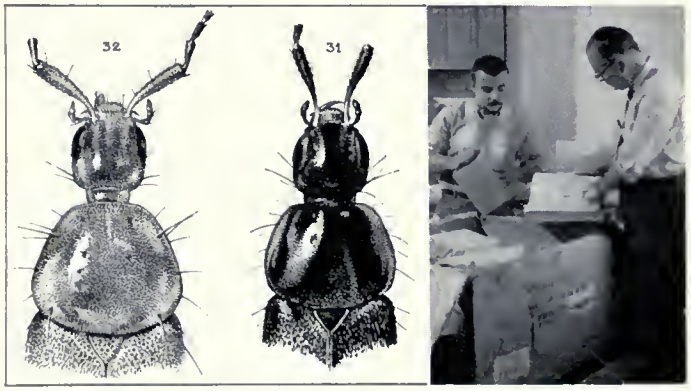
The rove beetles form one of the largest families of living things. More than 30,000 species have been named, and at least again as many are still to be described. The museum's study collection of these insects, which now approaches a quarter of a million specimens, includes more than half of the described species and ranks among the several most important in the world.

Alexander Bierig was born in Karlsruhe, Germany. An accomplished artist, he illustrated books and magazines. He was also an ardent amateur entomologist and specialized in the study of ground beetles (Carabidae). In 1923, at the age of 39, he emigrated to Havana, Cuba. There his entomological interests turned to the rove beetles. Between 1939 and 1940, he wrote 27 papers dealing with this family, and described more than 150 new species.

Through correspondence, Bierig became a friend of Ferdinand Nevermann, the "father" of Costa Rican entomology. In 1938, while on a collecting trip with Nevermann in Costa Rica, he was seriously wounded in a hunting accident that was fatal to Nevermann. He returned to Costa Rica in 1939 and established permanent residence there. Soon, he became Professor of Entomology at the University of Costa Rica in San José.

During his early years in Costa Rica, Bierig turned his attention to the Pselaphidae and published one short paper dealing with these beetles. However, most of the papers he wrote as a professional entomologist dealt with the biology and control of insects injurious to tropical crops.

Bierig retired from the University in 1950. He continued painting, producing some outstanding works and lived quietly until his death in 1963 at the age of 79, following a long illness. After his death, his collections and library suffered considerable damage and loss. However, his arranged collection of Staphylinidae and Pselaphidae was still largely safe when Dr. Rupert L. Wenzel, Curator of Insects, and Mrs. Wenzel went to Costa Rica in July to make final purchase arrangements and prepare the collection for shipment.



Two of the many fine drawings of beetles made by Bierig which were included in the collection of specimens. At right, Assistant Michael Prokop and Dr. Wenzel unpacking part of the collection.

THE STRENGTH OF THE TRIBE

by James Webb Young

Mr. Young, an Associate Member of Field Museum, has been deeply interested in Indian affairs for many years. He was a member of the Federal Indian Arts and Crafts Board, Department of the Interior, for a quarter-century and also belonged to the Indian Defense Association. He recalls here a trip made many years ago to the sacred country of the Taos Pueblo Indians. The story is pertinent today, for the Taos tribe is still engaged in its 60-year battle to preserve the religious character of the land, described by a member of the Taos Pueblo Council, Severino Martinez, as "the most important of all our shrines because it is a part of our life, it is our Indian church."

FROM TIME IMMEMORIAL the Taos Indians of New Mexico have lived on a high plateau at the base of the *Sangre de Cristo* mountains.

From an area of some 50,000 acres in these mountains, known as Blue Lake, comes all the strength of this tribe.

When one visits the Taos pueblo—as increasing numbers of tourists do today—it is easy to see in the clear mountain stream flowing through its plaza, how here "water rights" translate into "life's blood," for both domestic use and the irrigation of food fields.

But what is not so easy for us of an increasingly urbanized and industrialized society to understand is the passion of the Taos Indians for preserving the *sanctity* of the high mountain Blue Lake area whence these waters flow. For here also are the shrines, altars, and cathedral aisles of a religion which is inextricably woven into the fabric of Taos life.

Chief among the sacred and secret ceremonies held in the Blue Lake area are the annual rites which induct the boys into the tribe, after months of instruction and training.

In the summer of 1926 these ceremonies came under attack from some misguided missionaries, who charged that they were "pagan, sadistic, and obscene"—although no white man had ever viewed them. And this brought a threat from government agents to prohibit these ceremonies, thus striking at the very heart of the tribe's life.

Hence, almost in desperation, the tribal Council decided that their only salvation might be to have some trusted white witnesses to the coming Blue Lake ceremonies of that year. And for that purpose they invited John Collier, then Executive Secretary of the American Indian Defense Association, and myself, a member of that association, to accompany them.

For these ceremonies almost the whole tribe, except the very old and very young, make a two-day trek into the mountains, on horseback or afoot. We were to follow them, with horses, camp outfit, and guides provided by the Council. The photo at the left was taken on that trip. In it, I am at the left and John Collier is in the center. The other two men are guides.

When we arrived at the first night's camp the sun had gone down, and a light rain was falling. But we found a place set aside for us on the rim of a vast glade, in a grove of aspen trees so large they suggested cathedral columns. And all around the circle of this glade the Indian campfires were already brightly burning, suppers being cooked, horses stamping and neighing, and friendly voices chattering.

Our own fire was soon added, with stew and coffee pots going. Supper was eaten, and cigarettes lighted. Then suddenly, as though an order had been given, or a curtain come down, a pin-drop silence settled over the glade. And our guides were called to a conference out in its center.

The Cacique, head of the religious hierarchy of the tribe, had challenged the right of the Council to invite us to an essentially religious ceremony. And, as the conference had been unable to resolve the issue, it was submitted to us.

We at once said that we were not there to create dissension; we were sure our horses could find their way down the trail; and so we would saddle up and leave.

"No," was the reply. All were agreed that we could stay for that night's ceremonies, but should leave in the morning.

So, that being accepted, it was as though the curtain had gone up again. The camp came to life, wood was added to all the fires, and in their light the ceremonies began.

These consisted of dance after dance, with varying intervals of complete silence in between. Some dances included men, women, and children. Some men alone. Some with large groups, some with smaller. But all with the drum beating the rhythm, and most with the deep-toned men's chorus in the background. No dance, however, that either Collier or I could remember ever having seen before.

And so it went, throughout the night, in the light of the fires around the glade, framed by the towering white aspen.

Until the finale. There had been a longer period of silence than usual—perhaps half an hour—and all the fires had died down. Then, just as the first gleam of dawn showed through the aspens, out into the center of the glade came the shadowy figure of one man. And there, without drum or chorus, he delivered a solo invocation to the rising sun—ending just as its color began to streak the sky.

After that there was only profound silence again until the sun was fully up. Then all at once the glade was filled with the bustle of breaking camp. The Indians saddled up, as did we. They went up the mountains, and we went down—enabled to testify only to a night of sylvan magic and beauty.

JAMES W. VAN STONE JOINS MUSEUM STAFF

James W. VanStone has joined the staff of the Museum as Associate Curator of North American Archaeology and Ethnology. Dr. VanStone, born in Chicago, studied at Oberlin College and the University of Pennsylvania, and has served on the faculties of the University of Alaska and the University of Toronto.

His major research interest is in the cultures of the Indians and Eskimo of Alaska and northwestern Canada. He is at present involved in a long-range research project on the Eskimo of southwestern Alaska.

Dr. VanStone has published widely in journals, and serves as editor for several anthropology journals. He is the author of three books, the most recent of which is *The Ethno-Archaeology of Crow Village, Alaska* (*Bureau of American Ethnology, Bulletin 199. Washington*) which is in press at this writing.

CURATOR INGER HOLDS NSF BIOLOGY POST

Robert F. Inger, Curator, Reptiles and Amphibians, on leave from the Museum for one year as of September 1, 1966, is currently holding the post of Program Director for Environmental Biology at the National Science Foundation. Dr. Inger's appointment to this post follows three years of service as a member, from 1962 to 1965, of the environmental biology panel, a body of scientists which reviews grant proposals and makes recommendations to the Program Director concerning them.

Dr. Inger, on the Museum staff since 1946, has been Curator of Amphibians and Reptiles since 1954. Among his most recently published works is *The Systematics and Evolution of the Oriental Colubrid Snakes of the Genus Calamaria* (with co-author Hymen Marx), Volume 49 of the Museum's *Fieldiana: Zoology* series.

CONCERT SERIES OPENS AT MUSEUM

The Museum is pleased to host the second series of Showcase of Music Concerts presented by the Indiana University School of Music. The concerts, to be presented at 8:15 P.M. on four Tuesday evenings in the James Simpson Theatre, will open on November 15th with the Berkshire Quartet, an internationally famous string ensemble, about which *N. Y. Times* music critic Harold Schonberg wrote, "one of the finest (chamber music groups) in action."

Other concerts scheduled to be given are by The Indiana University Opera Trio on December 13th, The Baroque Chamber Players on February 28th, and The Indiana University Jazz Ensemble on April 18th.

Advance tickets for the concerts are available at no cost by writing the Museum.

CALENDAR OF NOVEMBER EVENTS

Museum open during November from 9 a.m. until 4 p.m. weekdays, until 5 p.m. on weekends.

November 12 Movie: MYSTERIES OF THE BALKAN WORLD
Producer Gene Wiancko narrates his colorful travel film.

November 15 Concert: THE BERKSHIRE QUARTET
First of four concerts presented by Indiana University School of Music.
8:15 p.m. in James Simpson Theatre. Write or phone museum for advance tickets.

November 19 Movie: OJIBWAY COUNTRY
Combines rugged adventure of the life of northern Ontario's Indians and the beauties of their wilderness home. Made and narrated by David Jarden.

November 19–20 ORCHID SHOW
Illinois Orchid Society's annual show exhibits hundreds of flowering plants in dramatic settings, all labeled with scientific and common names. Hall 9.

November 26 Movie: ONLY IN PORTUGAL
Religious shrines, wine-making country and big cities. Gerald Hooper narrates.
Movies at 2:30 p.m. in James Simpson Theatre; members' reserved seats held until 2:25.

NOVEMBER MEETINGS

Meetings open to club members and interested non-members.

CHICAGO SHELL CLUB, November 13 at 2 p.m.
Lecture by Mrs. Betty Lou Girardi

ILLINOIS AUDUBON SOCIETY, November 20 at 2:30 p.m.
The film, *Island Treasure*, will be shown.

Board of Trustees Adds Member, William Swartchild, Jr.

The election of William G. Swartchild, Jr., to the Board of Trustees of Field Museum of Natural History, has been announced by James L. Palmer, President. The action was taken at the October meeting of the Board.

Mr. Swartchild is president of Swartchild & Co.

He is a national advisory board member and national council representative of the American Ordnance Association and a director of the Chicago Post of the same organization. During the second world war he served with the Army Ordnance Corps, and is at present a lieutenant-colonel in the Ordnance Corps of the U. S. Army Reserve.

A director of Illinois Blue Cross, he is also an officer and director of Children's Memorial Hospital, a director of Michael Reese Hospital and Medical Center and a director of the Mid-America Club.

Mr. Swartchild, a native Chicagoan, is also a member of the Home Care Steering Committee of the Visiting Nurses Association. He has served as Chairman of the Executive Committee of the Health Division of the Welfare Council of Metropolitan Chicago, and of the Health Reviewing Committee of the Community Fund.

Mr. Swartchild is the sixth new member to join the Board of Trustees this year. His election brings its membership to 26. Until 1966 the Board was limited to 21 members, but a change in the by-laws now sets a maximum of 27 members.

FIELD MUSEUM
OF NATURAL HISTORY
ROOSEVELT ROAD AT LAKE SHORE DRIVE
CHICAGO, ILLINOIS 60605 A.C. 312, 922-9410
FOUNDED BY MARSHALL FIELD, 1893

E. Leland Webber, Director

BULLETIN

Edward G. Nash, Managing Editor
Beatrice Paul, Associate Editor

PRINTED BY FIELD MUSEUM PRESS

Volume 37, Number 12 December, 1966

BULLETIN **FIELD MUSEUM OF NATURAL HISTORY**

A curious historical event which took place on an artificial lake near Paris almost exactly 120 years ago is commemorated at the Museum by a small temporary exhibit in Stanley Field Hall this month.

George Catlin, the famous painter of American Indian life, had taken a group of Ojibwa and Iowa Indians on a tour of Europe. When they appeared before the French Court, a boat race was arranged between four Indians in a birch bark canoe and four French sailors in a "White Hall" racing boat, built in New York for the Prince de Joinville. Present were King Louis Phillipe of France, King Leopold of the Belgians and the royal families.

To everyone's great regret, the Indians lost. Catlin thought they might have

won if they had had only two men in the canoe, or "if they had put two squaws in it instead of the men, as they are in the Indian country much superior to the men in paddling canoes."

The race had been preceded by demonstrations of the Indians' skill at archery and lacrosse, as well as by several war dances. The ladies of the Courts were particularly interested in a young Indian mother and her papoose. After the race, the Indians and Catlin retired to a wing of the palace, where a feast awaited them.

The race was recorded both by Mr. Catlin and by M. Gudin, Marine Painter to the French King. Gudin's painting has been presented to the Museum by Mrs. A. W. F. Fuller. The painting and a reproduction of Mr. Catlin's drawing of the same scene are on view through the end of the year in Stanley Field Hall.

PROBLEM PIECE

An Axe-Handle from Africa

by Leon Siroto, Assistant Curator, African Ethnology

NEAR THE OFFICE of the Anthropology Department is a case containing diverse artifacts; the front panel bears a prominent question mark. The items within represent the more difficult problems found in our large collections of well identified ethnographic material. This display was set up to draw attention to our lack of information about the origin of these problem pieces or, in many cases, their intended use. We hope that visiting colleagues can relate these enigmas to something from their areas of special interest.

In the natural sciences the differentiation and elaboration of forms follows regular and limited lines; the literature dealing with these forms is expected to be comprehensive enough to avoid major problems of identity.

The curators of a museum's anthropological collection face a different problem. The range of possible forms, of human inventiveness—especially in non-essential aspects—makes a comprehensive visual catalogue unlikely. The perplexed curator looks not so much for published counterparts of the entire artifact as for small features that relate to a definite region or, with better luck, a certain culture.

A clue of this sort saved a recent acquisition from being consigned to the department's problem case. This object, a wooden axe-handle carved in human form, was given to the Field Museum this year by Mr. and Mrs. John J. Klejman of New York City. Other than being African, its origin was unknown.

A high vertical slot passes through the trunk of the presumably male figure. This slot doubtless served to hold a long-tailed, iron axe-blade. The method of setting the blade into the handle, the estimated width of the blade and the ornamental nature of the handle recall the East Coast of Africa. Then, a minor feature serves to narrow down the search for a region of possible origin.

On the back of the figure's "skirt" and on several ornamental bands around the shaft itself occurs a decorative motive that seems to be limited to the northern part of Mozambique (Portuguese East Africa) and coastal and southern Tanzania. This form, a concave, broad ellipse, is found modified and combined in various ways throughout this area. It probably derives from the decorative tradition of the Zanzibar Arab culture in which a similar form is important in the floral embellishment of house parts. The other decorative motives on the axe-handle are less distinctive of the region but are nevertheless often found in combination with the "petals" that supplied the first clue.

Within the area of possible origin there is one people who seem especially given to the use of this motive in the decoration of wood carving. This people, the Makonde, seem remarkable for their

traditional practice of carving masks and figures in a region otherwise lacking in representational art.

This predilection has not been satisfactorily explained. Rather than being an isolated phenomenon, it could relate to the Makonde stubbornly holding fast to old beliefs and skills while the influence of Arabs in the north and Nguni (cattle-raising and militaristic Bantu) in the south wore down traditions of sculpture held by adjacent peoples. The Makonde plateau, considered a natural fort, probably strengthened this conservatism. The Makonde, a Bantu-speaking people, depend upon the cultivation of maize, sorghum and cassava. They formerly lived in small, compact hamlets which were quite difficult to find in the dense bush of their plateau.

The head of the axe-handle is not carved in characteristic Makonde style. The face is somewhat naturalistically modeled and lacks the characteristic, almost inevitable lip-plug. The stance is angular. The shoulders are transformed into a shelf-like structure which, while it seems to be unique in East African figure sculpture, could relate to the hafting of the blade, providing a strut for protection of the otherwise fragile head-dress.

Once we consider a Makonde origin we must take account of certain features that make any other assignment difficult. The head-dress, which seems to represent a queue of hair hanging down to shoulder level, occurs among a sub-group of the Makonde called the Mawia. We find it on heads, representing Mawia men, carved as decorative handles on the covers of boxes for snuff and medicine; the feature seems not to occur in the traditional style of any other East African people. On the figure's brow and temples are clusters of squarish knobs simulating ornamental scarification, a practice more highly developed among the Makonde than other peoples in Tanzania and Mozambique.

Although reminiscent of the Makonde tradition, the style is not close enough to give complete assurance. To the north and west of the Makonde complex there are little-studied peoples whose carving shows some concern with art. This vagueness around the edges of this style province suggests that it is best to express doubt by saying "probably Makonde."

The feature that would most conclusively establish the Makonde identity of the figure is ambiguous. In most Makonde carving the upper lip protrudes very markedly. This convention depicts the characteristic lip-plug worn by all Makonde women and by men of the Mawia sub-group. The upper lip of our figure does not protrude, but does show a round pit.

We cannot with any certainty determine the nature of this pit. It may represent the hole left by the removal of the lip-plug. The greater likelihood, however, is that an ornamental carving would show all ornaments in place rather than indicate their former presence. Possibly a bit of some material was once imbedded in the pit; if so, no trace remains. The heads of small iron nails that represent the eyes are still in place. Five brass upholstery tacks also remain above and alongside the blade-slot; (these European trade-items decorate traditional

Clues to the origin of the decorative motives on the axe-handle are a composite door-frame (detail far left) said to be from "German East Africa," but in the tradition of the Zanzibar Arab culture; and beneath it, a gunpowder box and three box lids from the Makonde region. Fifty years ago all men wore these wooden containers on their belts. The actual-size segment of axe-handle at left shows petal motive common to all three illustrations, and zig-zag motive found on some of the box lids.

Possible form and ways of hafting the missing blade, suggested by complete specimens collected in the region around the Makonde.

The face on the axe-handle, much enlarged, showing the pit in the upper lip. Compare with the photograph beside it of a Mwera woman (a Makonde group), showing lip-plug and ornamental raised scars. (After Kuesters, 1930.)

Profile of the head of the figure on the axe-handle, showing the sort of headdress said to have been worn by Mawia men (a Makonde group). Note its similarity to the headdress on the carving of a Mawia man, far right. This drawing is after one by Weule, 1908, showing the knobbed lid of a box.

sculpture in many parts of Equatorial Africa.) We cannot overlook the possibility of the pit being a way of reproducing the natural groove of the upper lip.

Having to stop short of the conclusive argument is disappointing; the combination of a man's lip-plug and queue-like hairdress would enable us to attribute the artifact to the Mawia. Were we certain that the piece had been made by a Mawia or by a carver of another group who was attempting to depict a Mawia type, we might be able to say something about the possible age of the piece.

The distinctive headdress is found only in sculpture. We can assume, therefore, that it became obsolete sometime before the Makonde were studied by thoroughgoing German ethnologists at the beginning of this century. This, together with the finish and careful workmanship of the piece, could suggest that the axe-handle came into being around the end of the last century. Old styles of dress, however, are often "fossilized" in sculpture styles, being represented long after their abandonment.

The treatment of the lower body is distinctive but of little diagnostic value. Clothing seems to be represented, an unusual feature in African traditional sculpture. The nature of the garment, however, is not clear; its form could allude to a strip of fabric—narrow in front and flaring behind—passed between the legs and held under a wide belt. We have

little direct evidence for the traditional attire of Makonde men: most of the statues represent women. The Makonde wore garments of hide, bark cloth and domestically woven cotton.

The absence of a blade may keep us from sufficiently understanding both the general form and the special features of the handle. The wood could have been shaped to bring out the special qualities of the worked iron. (The same man could have fashioned both parts; in many societies smith and wood-carver were one.) The ornateness of the handle suggests a blade well decorated, possibly by engraving or openwork. We know nothing of the relative importance of blade and handle in traditional African attitudes toward ornamental implements. In the case of certain types of axe, greater care and imagination are expressed in the making of the blade, but this cannot be advanced as a rule for all types.

The original use of the object is as imprecise as its origin. Although we see that it was intended to serve as the handle of an axe, we cannot imagine it used in hewing. The shaft is too thin and the form of the figure too attenuated to hold up under working conditions. The height and thinness of the slot indicates a wide flat blade, probably more ornament than tool.

At best, this axe did only minimal work as a tool. Its main role was evidently symbolic. Its decorative quality leads us to class it with other axes characteristic of many traditional African cultures. These axes make up a category determined by their ornamental nature; they are related to ceremony, ritual, and display for personal prestige. Implements of this sort are often thought of as "dance axes," on the vague supposition that these rituals and displays are expressed primarily through the dance. Those authors who refer to implements of this sort as "battle axes," usually do not tell whether they were used in combat or in peripheral display.

Knowledge of the use of ornamental axes in most African societies is superficial. It is generally believed that ceremony is important in simpler cultures and that ceremony requires interesting paraphernalia. Thus, any object of carefully worked and unusual aspect is, in the absence of precise information, written off as "ceremonial." Published sources offer very few accounts, detailed or otherwise, of the ceremonies which purportedly gave these objects their reason for existence.

A simpler and probably more acceptable explanation of weapons and tools of a primarily ornamental nature is found in the high regard of traditional Africans for skillful workmanship. Although they do not concern axes, cases abound of traditional African leaders and communities seeking to establish respect and fame through the ownership of objects showing remarkable beauty, complexity or ingenuity. It is impossible to separate these goals and their pursuit from religious beliefs, but, as far as our information goes, ornamental versions of implements can come into being to fulfill certain realistic objectives and personal needs.

We must remember that in many African societies experience of the diverse and extraordinary was, in relation to our own, very limited. The ownership of a remarkable object made for a remarkable man. In the pre-state societies of traditional Africa, prestige attained or increased through the possession of unusual artifacts could relate closely to the prospects of wealth and leadership for a man or a community. The connection between leadership and art was no less apparent then than it is in our own culture today. We read of chiefs lending their specially made staffs or weapons to messengers as an assurance of safe conduct and proof of position in the chief's trust.

In many societies such artifacts were not duplicated; once made, they became emblem of the owner's uniqueness. The history of one African community—a village of the Ibo in eastern Nigeria—dramatically illustrates this principle. Its leaders hired an expensive carver to fashion an enormous and unusually decorated message-drum. As the carver was about to return to his village, it occurred to the villagers that their symbol of excellence might be surpassed by his subsequent commissions. To be certain that they would own the artist's crowning achievement, they killed him.

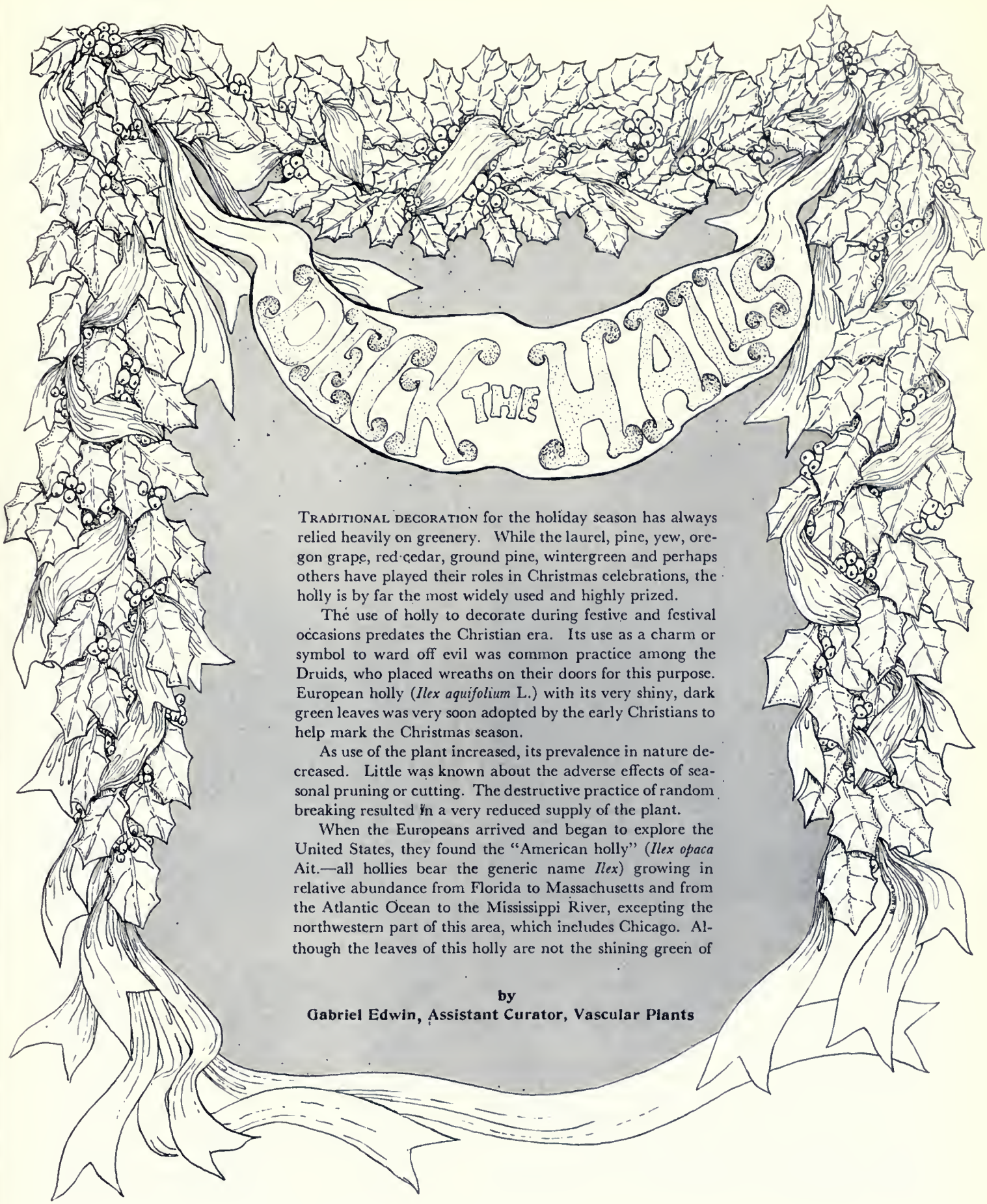
Without visualizing any such macabre background for the axe-handle under discussion, we do note that nothing quite like it has been published. It, too, may have been a costly, unique creation destined to be the emblem of a man who had attained or aspired to great importance in his society.

Living in small independent communities, the Makonde probably had a great number of chiefs who could claim to be important. Personal distinction and prestige would thus have received considerable stress.

Why an axe as a symbol of status? As African informants seem not to give any explicit answer, we must piece together possible reasons from what we learn of their cultures. In many parts of Africa the axe is a prime essential of cultivation; without it, the land cannot be cleared for planting crops. In many of the less elaborate cultures—such as that of the Makonde—an important man is by definition the head of an important family. A family's importance is often measured by its claim to the land: it is among the first settlers and farmers. In this sense the axe can bear a symbolism akin to that of "the plow that broke the plains" in our own culture. Its carrying or wearing (ornamental axes often have long blades which allow them to be hooked over the shoulder) could serve as an elegant statement about the owner and his relationship to his land and people.

The axe hews and fells, but it also splits. Perhaps the most important function of the family head is the division and apportioning of various essentials of life. He decides upon the sharing out of farmland and village space to his followers. The distribution of meat to units within the extended family under his leadership can depend upon the use of an axe. In many, if not most, African languages, one settles a dispute by "cutting" it; the axe can thus have a judicial significance.

As ideas of technology and social organization run together in our attempt to explain the symbolism of an ornamental axe, we can assume that an artifact whose background is so nuanced can serve as an important point of departure in our learning of its makers and their way of life. This particular acquisition is important for its unusual style, but no less so for the questions it poses about the social and cultural background of ornamental axes in Africa.



TRADITIONAL DECORATION for the holiday season has always relied heavily on greenery. While the laurel, pine, yew, oregon grape, red cedar, ground pine, wintergreen and perhaps others have played their roles in Christmas celebrations, the holly is by far the most widely used and highly prized.

The use of holly to decorate during festive and festival occasions predates the Christian era. Its use as a charm or symbol to ward off evil was common practice among the Druids, who placed wreaths on their doors for this purpose. European holly (*Ilex aquifolium* L.) with its very shiny, dark green leaves was very soon adopted by the early Christians to help mark the Christmas season.

As use of the plant increased, its prevalence in nature decreased. Little was known about the adverse effects of seasonal pruning or cutting. The destructive practice of random breaking resulted in a very reduced supply of the plant.

When the Europeans arrived and began to explore the United States, they found the "American holly" (*Ilex opaca* Ait.—all hollies bear the generic name *Ilex*) growing in relative abundance from Florida to Massachusetts and from the Atlantic Ocean to the Mississippi River, excepting the northwestern part of this area, which includes Chicago. Although the leaves of this holly are not the shining green of

by
Gabriel Edwin, Assistant Curator, Vascular Plants

though the leaves of this holly are not the shining green of the old world species, the two have in common prickly leaves and copious production of red berries. Of the approximately 600 species of holly occurring throughout the world, only about six have bright red berries and sharp, spiny leaf-margins. This new world holly plant was soon put to use in the historic way. There are over 20 other species of holly in our country but only *Ilex opaca* has caught on for wreath, sprig and other related uses.

When the settlers were few in number and clustered along the eastern seaboard, the cutting and pruning of the plants presented no problem. Almost everyone had at least one plant growing nearby, and his needs were modest enough so that the relatively few sprigs taken each year did no lasting damage. It should be noted that holly plants are either male or female. Since only the female bears the desired bright red berries, cutting is almost always restricted to this sex.

However, with increasing population and growth of cities, the inevitable came to pass; a decrease of woodland sites available for plants, holly included. The net result was fewer female American hollies farther away from their place of use. With the passing years ever greater demands for sprigs and wreaths were put upon each surviving plant, the same as with the European holly.

In time, it became so difficult to get holly cuttings that the expense prohibited most people from using hollies at Yuletide. Nevertheless, the most binding demands of tradition

At left, a beautiful American holly tree, Ilex opaca, *just north of Baltimore, Maryland. Our cover illustration, also* Ilex opaca, *is from a Field Museum Herbarium specimen, collected in York County, Pennsylvania in 1892. This Herbarium sheet is one of the more than 2½ million in our botanical collections, which are the fifth largest in the world.*

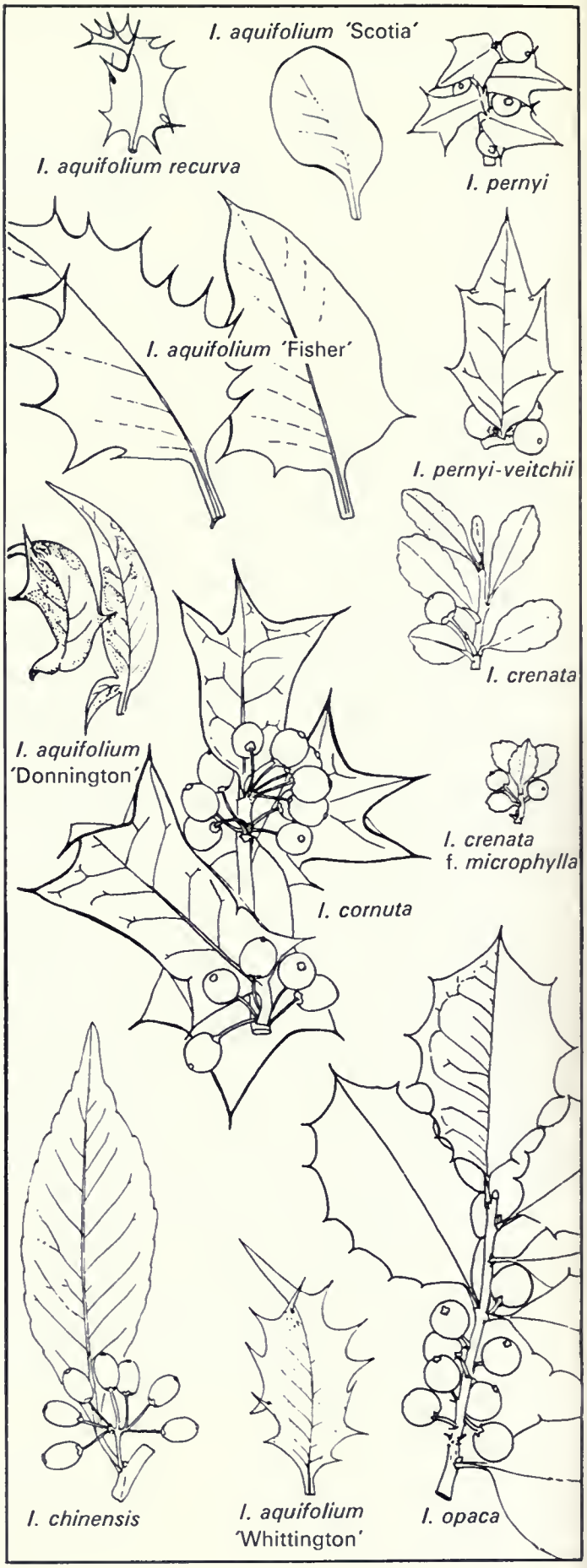
At right are leaf forms of various English, American and Oriental hollies.

Facing page shows Ilex opaca *"Cumberland," left, and* Ilex opaca *"Knight," two commercial varieties.*

continued, and the cry for pieces of the plant did not abate.

At about this time, circa 1840, small groups of men, boys, and occasionally women and girls, often in family units, undertook to supply the demand. Thus were born the "holly-breakers." It may have been a labor of love or for profit or both, but in any case little is written of these people in the literature of American folklore.

Let us picture very briefly the times in which they worked —transportation by foot or pack animal, refrigeration none, communication tediously slow. Christmas falls at the time of year that (in our latitudes) is the least favorable for plant growth and since refrigeration was non-existant, the "breakers" were forced to collect their materials when conditions for gathering cuttings were at their worst. Once collected, it



was imperative to get the yield to market as quickly as possible at the time that transportation was slowest; a dried sprig has little or no value for ornamental purposes.

The sparse records of hollybreakers contain stories of death by freezing, and extreme suffering from exposure. This one, probably true and certainly typical, illustrates the hardships endured by the hollybreakers.

In the 1850's near the city of Pocahontas in West Virginia, a father and son on or about December 10, proceeded to climb a mountainside (probably the famed South Mountain) for the purpose of breaking holly to carry to market. The weather was cold and clear when they began, but while cutting the plants they were overtaken by a snowstorm and separated. Only the son returned the next day with a load of holly on his back. He had been severely frost-bitten and otherwise badly used by the elements. At the clearing of the storm, a search for the father was undertaken. He was found dead on the mountain slope with his "crop" nearby. When the search party returned to the home with their burden, the son, too, was found dead as a result of the exposure he had endured.

The hollybreakers were not the only sufferers. Since it was necessary to cut as much as possible from each plant in order to make the task economically feasible, many stands of plants were destroyed. The damage to both man and plant is the basic fact in what little is known of the practice. By 1885, hollybreaking had come to an end.

Increased knowledge acquired after the turn of the century brought the realization that holly could be cultivated over much of its range. Contemporaneously, early breeding experiments, especially in England at Kew Gardens, resulted in a number of new and attractive forms of the European species. By 1960, over 300 desirable varieties were listed in England's catalogues.

With this work as a spur, breeders in the United States began to employ our species. To date almost 200 horticultural varieties have been developed. Most recent work has centered on the possibility of crossing the English or European type with the American, in order to breed the "shiny leaf" into the usually dull-leaved *Ilex opaca*.

These two species are essentially incompatible. Few if any fertile offspring result from direct crosses. In the course of experimentation it wss discovered that offspring of crosses between American holly and certain Asiatic species could be readily crossed with the English hollies, and so obtain many healthy hybrids. These crosses give promise of eventually producing the desired forms.

As a few Asiatic species of hollies were used in breeding and hybridization researches, others were introduced for their particular horiticultural merit. For centuries, numerous species were cultivated throughout the Far East, especially in Japan and China, for their beauty of growth form and foliage, as well as for berry production. In the past fifty years, over sixty species have been imported from this area. A number of these such as *Ilex cornuta* (Japanese holly), its form *buford*, *Ilex pernyii*, *I. chinensis*, *I. pernyii-veitchii* (a hybrid of two Asiatic species), *I. crenata* and *I. rotundifolia* have gained wide acceptance especially in our southeast. These species can be found in both informal and formal gardens. They are extremely resistant to disease, which makes them doubly valuable. Lately these and other hollies have gained acceptance as Christmas plants.

A still untapped source of possible gene material to produce new and useful types of holly is found in the 200 tropical American species. Although truly attractive plants are relatively few in number, those few have great beauty and are certainly worth serious investigation, especially *Ilex obcordata* (found on the Island of Jamaica), *I. boliviana* of the Andes

mountains, and *I. microphylla* of eastern Brazil. These species, exotic at present, may well be developed into a major source for future Christmas decorations as well as year-round adornment for our homes and streets.

Certain evidence exists that at least some hollies can be grown over much of the United States if given careful attention. Breeding for hardiness in our local climate, as well as in others, proceeds concurrently with breeding for leaf-color and other useful characteristics. Given suitable time, a holly will no doubt be developed which incorporates all or many of these desirable traits. When that day arrives, it will be commonplace to see Christmas holly in our yards and lawns the year around. Until then, we will be obliged to purchase our holly wreaths and sprigs as we do our Christmas trees.

PUBLICATIONS BY

NEARLY A DECADE AGO, I wrote in the BULLETIN that the life-blood of science is the stream of published research papers, large and small, which comprise the "current literature" conveying the information we read from specimens to those who get their information by reading the printed word . . . our public.

I then examined the extent to which a Harvard professor used material from Field Museum zoologists in writing a book on animal distribution. I found he cited thirty papers by our curators in his bibliography and gave them seventy-five page-references in his index. This was a gratifying record.

With the publication of Field Museum's Annual Report for 1965, it is opportune to look at the scope of our activity as reflected in the publications of our zoology staff listed there. Ten curators are listed, with forty published papers varying in size from one to 351 pages. Twenty-two different publishers were used to present these forty papers to the public. Field Museum put out seven of them. Others were published by two other museums, the U. S. Department of Agriculture, World Health Organization, Illinois Society of Medical Research, three commercial publishers, general scientific journals such as *Science*, *Nature*, *Quarterly Review of Biology*, *Natural History*, and more specialized journals such as *Ibis*, *Veliger*, *Puku*, and the *Journal of Mammalogy*. Sixteen of these publications are American, five are European and one is African.

The groups of animals treated include mammals, birds, reptiles, fishes, insects and mollusks. The parts of the globe they represent include all continents and many islands, as a selection of key words from titles indicates: Africa, Australia, Bahamas, Bechuanaland, Barotseland, Cameroun, Colombia, Egypt, India, Indochina, New Jersey, North America, and Thailand.

It is as interesting to look at the audiences for whom these papers are written, as at their content. Most are written for our colleagues interested in the same geographical areas and the same groups of animals. Again, key words of a different sort selected from some of the titles indicate their content and approach: Systematics and evolution (snakes); Relationships and zoogeography (snakes); A study of squirrels; Taxonomy and nomenclature (birds); Interesting birds from Barotseland; A whale new to the western hemisphere; A new species of squirrel fish; A winter plumage (bird) and a mutant (bird). Quite properly, specialized scientific papers represent the greater part of our work.

But some of our research goes beyond the supply of more information and different approaches for other specialists in the same fields. Two papers point out that modern concepts in systematics can be adopted to advantage by those using experimental caged monkeys in medical and psychological studies. Another paper deals with bird migrations; the ticks born by the birds and their role in the occurrence of arthropod-born viruses and related diseases in North Africa.

The book reviews our staff members were requested to write drew on our specialized knowledge to comment on

STAFF MEMBERS

problems such as speciation and parasitism, as well as on faunal papers and check-lists. Some reviews received much wider circulation than the original papers themselves, especially in such general journals as the *Quarterly Review of Biology* and in *Natural History Magazine*.

Beyond research and its publication, there is yet a further aim to our writing. This is to convey knowledge and an appreciation of the living world to the non-scientist. The teachers in universities who read our research papers may do some of this in their teaching but we do some of it directly. "A New Dictionary of Birds" is a monumental volume, encyclopedic in character and vivid in treatment, that helps eliminate some of the gaps between the specialist and the amateur naturalist. Members of our curatorial staff contributed a number of sections to this cooperative work.

At still another level, our staff contributed sections to the two volumes on North American birds put out by the National Geographic Society, written and illustrated to appeal to that wide audience of nature lovers lacking special knowledge.

Children's books by staff members are available both in English and in translations. From this form, requiring quite specialized skills, to the most abstruse scientific paper, from BULLETIN article to book, there is a continuous effort by the staff of all four departments of the Museum to present the natural sciences to various audiences: fellow scientists, Members of the Museum, and the interested layman.

—Austin L. Rand, Chief Curator, Zoology

recent acquisition geology

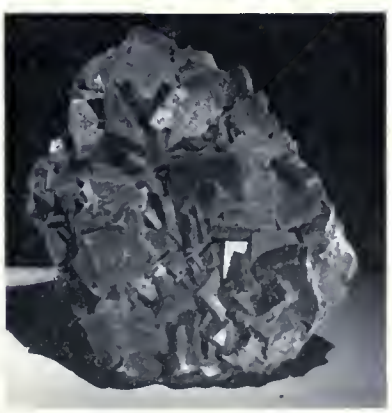
MINERALS FROM BRAZIL, U. S.

Thirty-seven selected mineral specimens, collected by Mr. Glen Commons of Aurora, Illinois, are on display this month in Stanley Field Hall. Recently donated by him to the collections of Field Museum, they are outstanding examples of their kind in size, degree of perfection, and in some cases, rarity

The largest piece, illustrated below, 12 inches long, 10 inches wide and 8 inches high, is a marcasite from Galena, Illinois. Shown with it in the center case are specimens of indicolite, brazilianite, rose quartz, rubellite with albite, and a very large piece of quartz intergrown with tourmaline, all from Minas Gerais, Brazil, as well as two specimens of danburite with quartz from Mexico.

The west case contains five specimens from Brazil and Illinois, among them a marcasite from Galena of an interesting domed form. Others displayed in this case are apatite and tourmaline from Minas Gerais, Brazil.

The east case shows five large fluorites from Hardin County, Illinois. Their strong rectilinear crystal structure is clearly visible on the surface of the rocks, as seen in the bottom illustration. The colors range from white-grey in the specimen containing shalerite and calcite, to very dark purple, almost black, in the others.



These minerals have been accessioned and cataloged into the study collections of the Department of Geology, where they join many thousands of other specimens from all parts of the world, gathered by the field collecting of staff members, purchases, exchanges and, often, as gifts from interested friends of the Museum.

DR. WEISS TO DELIVER SCIENCE LECTURE

The fifth annual Holiday Science Lectures, presented by The American Association for the Advancement of Science and Field Museum of Natural History will be held at the Museum on December 28 and 29. The program provides selected high school students and teachers with the opportunity to hear eminent scientists talk about their work. The general purpose of the lectures is to broaden the scientific horizons of the audience and to communicate to them some of the excitement and inspiration of scientific endeavor. The program is made possible by a grant from National Science Foundation.

Dr. Paul A. Weiss, of the Rockefeller University, will be this year's speaker. Dr. Weiss has received international recognition for his experimental and theoretical studies in the biological sciences. He will talk to the students and teachers on "Living Form—The Nature and Origin of Pattern." He will tell how the ordering of elements in space and time gives a living organism its form, and what progress is being made in increasing man's understanding of life.

1965 Holiday Lecture

Dr. Paul A. Weiss

In past years, the Holiday Science Lectures have been received with enthusiasm by both students and teachers. Field Museum co-sponsors them as part of its rapidly expanding educational program.

PHILIP H. LEWIS TO NEW MUSEUM POST

Phillip H. Lewis, formerly Curator of Primitive Art, has been appointed Curator of Primitive Art and Melanesian Ethnology. He was awarded a Ph.D. degree in anthropology by the University of Chicago in September. His dissertation, entitled "The Social Context of Art in Northern New Ireland," was based on field work carried out in New Ireland. Dr. Lewis will continue his special research interest in the art and ethnology of Melanesia. He has just returned from a month's trip in Europe to study the New Ireland collections in the museums in Hamburg, Bremen, Frankfurt, Stuttgart, and Basel in preparation for a future field trip to New Ireland.

MUSEUM MEMBERSHIP UP

Membership in Field Museum of Natural History has doubled in the last ten years and is approaching 12,000. The most dramatic increase occurred in the past year, which saw a 15% rise in the Membership. The increase was due, in part, to the public's growing interest in the natural sciences, and to their awareness of the importance of The Museum to the cultural and educational life of Chicago.

Also important was the intensified effort by Field Museum to broaden its base of popular support. There are Members in most states and many foreign countries.

MEETINGS: Illinois Audubon Society, January 4 at 7 p.m.
Chicago Shell Club, January 8 at 2 p.m.
Chicago Nature Camera Club, January 10 at 7:45 p.m.

The Museum will be closed on Christmas Day and New Year's Day. Hours for December and January are from 9 a.m. until 4 p.m. on weekdays; until 5 p.m. on weekends and during the week of December 26th.

FIELD MUSEUM OF NATURAL HISTORY
Roosevelt Rd. & Lake Shore Drive
Chicago, Illinois 60605

Founded by Marshall Field, 1893

BOARD OF TRUSTEES

Lester Armour
Harry O. Bercher
William McCormick Blair
Bowen Blair
William R. Dickinson, Jr.
Joseph N. Field
Marshall Field
Paul W. Goodrich
Clifford C. Gregg
Samuel Insull, Jr.
Henry P. Isham
Hughston M. McBain
Remick McDowell
J. Roscoe Miller
William H. Mitchell
James L. Palmer
John T. Pirie, Jr.
John Shedd Reed
John G. Searle
John M. Simpson
Gerald A. Sivage
Edward Byron Smith
William Swartchild, Jr.
Louis Ware
E. Leland Webber
J. Howard Wood

HONORARY TRUSTEES

Walter J. Cummings
William V. Kahler

OFFICERS

James L. Palmer, President
Clifford C. Gregg, First Vice-President
Joseph N. Field, Second Vice-President
Bowen Blair, Third Vice-President
Edward Byron Smith, Treasurer and Assistant Secretary
E. Leland Webber, Secretary

DIRECTOR OF THE MUSEUM

E. Leland Webber

CHIEF CURATORS

Donald Collier, Department of Anthropology
Louis O. Williams, Department of Botany
Rainer Zangerl, Department of Geology
Austin L. Rand, Department of Zoology

BULLETIN

Edward G. Nash, Managing Editor
Beatrice Paul, Associate Editor

PRINTED BY FIELD MUSEUM PRESS